Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

OCTOBER, 1948

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DETROIT

Hot Strip Mills

Designed and Built by MESTA

Mesta 68" Four-High
Continuous Hot Strip Mill, Universal Stand

DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS

MESTA MACHINE COMPANY · PITTSBURGH, PA.

Continental

BAR MILLS

CORRECTLY ENGINEERED
FOR TODAY'S REQUIREMENTS

Continental

Continental

FOUNDRY & MACHINE CO.

CHICAGO · PITTSBURGH

Plants at East Chicago, Ind. · Wheeling, W. Va. · Pittsburgh, Pa.

Industry's Headquarters for
Rolling Mills and Equipment
Iron and Steel Rolls
Carbon and Alloy Steel Castings

TECHNOLOGY DEPARTMENT

Aetna-Standard

Newest development in continuous butt weld pipe—a 10 stand mill.

Aetna-Standard is now completing the two fastest seamless tube mills in the world.

AETNA-STANDARD leads the world in engineering, designing and building of seamless tube mills and continuous butt weld pipe mills. They build more pipe and tube mills than all other companies combined.

DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries

THE AETNA-STANDARD ENGINEERING COMPANY · YOUNGSTOWN, OHIO

ASSOCIATED COMPANIES:

HEAD, WRIGHTSON & COMPANY, LTD., THORNABY-ON-TEES, ENGLAND

AETNA-STANDARD ENGINEERING COMPANY, LTD., TORONTO, ONTARIO, CANADA

NATIONAL ROLLS

Stand the Gaff!

The men who know rolls best are those who work with them daily . . . on the stands . . . in the roll shop. They are in a front line position to judge roll performance and value. Ask them what they think. We'll gamble they'll tell you that National Rolls fully meet and frequently exceed service expectations.

At National, correct metallurgical composition, uniform casting and precision turning combine to provide maximum strength and durability. And whether your requirements call for iron or alloy iron rolls in rough, necked, rough turned or finished form, National is staffed and equipped to competently and speedily produce them.

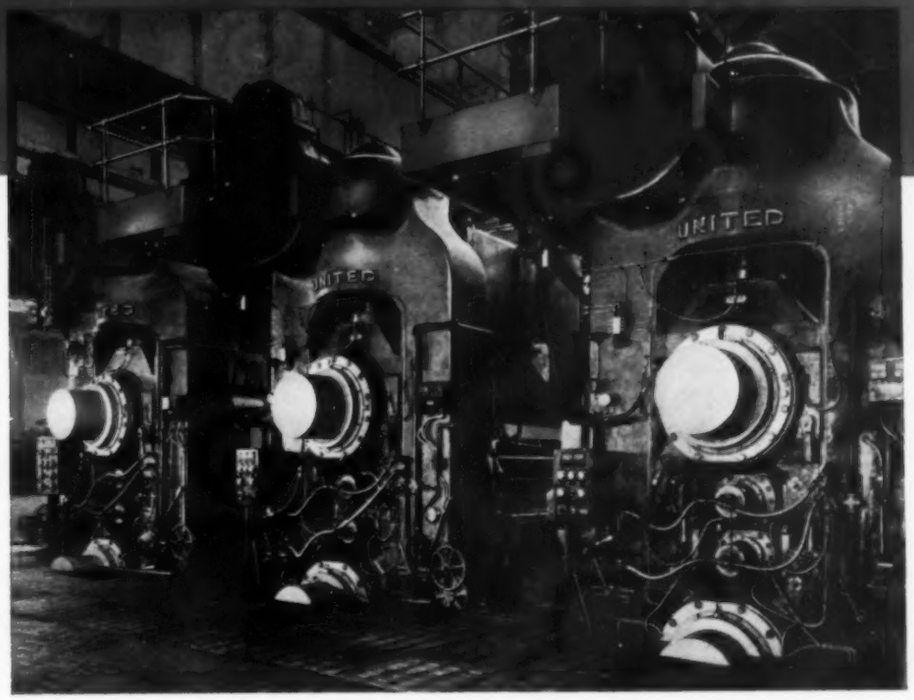
National Rolls

THE NATIONAL ROLL & FOUNDRY CO.

AVONMORE, PENNSYLVANIA

SPECIALISTS IN IRON AND ALLOY IRON ROLLS

Protect Roll Bearings 3 ways



Texaco Regal Oils guard against
❶ friction ❷ heavy loads
❸ high temperatures

BEST way to avoid unscheduled shutdowns due to bearing trouble is to keep your oil circulating system clean. Do it with *Texaco Regal Oils* — turbine-grade oils that resist oxidation, emulsification and sludging . . . keep oil lines clear and bearings protected with an uninterrupted flow of cool, clean lubricant.

Texaco Regal Oils are made to carry heavy loads easily . . . to stand up under high temperatures and speeds. Their use maintains trouble-free performance and reduces maintenance costs in mills everywhere.

For heavy-duty enclosed gears, use *Texaco Meropa Lubricants.* Their load-carrying capacity is ample for the heaviest service. In addition, they prevent bearing corrosion . . . assure longer life for both gears and bearings.

Let a Texaco Lubrication Engineer help you to greater efficiency and economy throughout your plant. Just call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils
(HEAVY CIRCULATING OILS)

Tune in . . . TEXACO STAR THEATRE every Wednesday night starring Milton Berle. See newspaper for time and station.

DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS

Here's how

Chemical Scale Removal Service

SAVES TIME AND MONEY FOR STEEL PLANTS!

Steel plant operators who rely on Dowell for chemical scale removal service for heat-exchange equipment find it quick, effective, safe—and economical. Blast furnace cooling systems, for example, may be cleaned *without shut down*—and real savings result!

Dowell engineers fill the equipment to be cleaned with specially selected liquid solvents designed to dissolve and disintegrate scale and sludge deposits. Dismantling is unnecessary; down time is reduced to a minimum. Every step of the work is planned and carried out by trained Dowell personnel—and Dowell supplies the truck-mounted tanks, pumps, heaters, mixers and control equipment.

Get the *facts*. Call the nearest Dowell office for estimates and full data on chemical cleaning service for:

- Blast furnaces, open hearth furnaces
- Boilers, condensers, economizers, feed water systems
- Engine, compressor and blower jackets
- Rolling mill cooling systems
- Locomotive boilers
- Water wells, water lines and piping
- Coke plants—scrubbers, coolers, precipitators, gas lines
- Building heating, air conditioning, steam and water distribution systems

CALL

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

New York	Buffalo	Wichita	Mt. Pleasant, Mich.
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Long Beach, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

YOU USE 4 + 8
YOU GET 100,000

That's all it takes! Four basic circuits and 8 basic component parts give you more than 100,000 different electronic instrument combinations for processing use.

Flow, level, speed, pressure, temperature, gas analysis, pH, conductivity, etc.—all can be controlled with these interchangeable Bailey units.

With Bailey controls, replacement part stocks are held to a minimum because parts are interchangeable. Maintenance costs are less, too, because maintenance men quickly become familiar with the standardized Bailey units.

Bailey bulletin No. 17 shows how you can use this improved control system. Write for your copy and keep it handy for reference the next time you need process controls.

P-19

BAILEY METER CO.
1047 Ivanhoe Rd. • Cleveland 10, Ohio
BAILEY METER CO. LIMITED, MONTREAL
Controls for the Steel Industry
TEMPERATURE • FLOW • PRESSURE
GAS ANALYSIS • LEVEL • RATIO

4 + 8 Works Here at the Irvin Works of the Carnegie-Illinois Steel Corporation.

THE NEXT MOVE IS YOURS

FOR GEAR DRIVES, PINION STANDS OR COMBINATION UNITS – built to suit your needs exactly—you only have to tell us your requirements. We will do the rest, supplying you with a *designed-for-the-job* unit capable of withstanding the shocks, stresses and wear encountered in continuous, heavy duty service.

REDUCTION GEAR DRIVES – Single, double and multiple reduction units, in a wide range of ratios and capacities. Precision cut gears, generated by the famous Farrel-Sykes process, provide extra load-carrying capacity and smooth, quiet operation.

PINION STANDS – Double or single helical pinions mounted in sleeve or roller bearings, carried in heavy cast cases and provided with automatic lubrication. Built in any size, for any capacity.

COMBINATION UNITS – Include reduction gear drive and pinion stand in a compact, integral unit.

The next move is yours. Why not call on us when planning your new mill drive? Our engineers will be glad to discuss gear drive problems with you at any time, without obligation.

FARREL-BIRMINGHAM CO., INC. • ANSONIA, CONN.
Plants: Ansonia and Derby, Conn.; Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Chicago, Los Angeles, Tulsa, Houston

FARREL CENTENNIAL 1848 1948

Farrel-Birmingham

FB-477

6 INSIDE REASONS for Choosing..

the RELIANCE

GEARMOTOR

1 Helical, wear-hardened gears cut from alloy steel forgings and shaved before hardening for correct eccentricity and helical angle and bright, smooth surfaces—factors contributing to quiet operation and longer life.

2 Gear arrangement in simple train minimizes number of moving parts—promotes quietness.

3 Pinion and gear supported and spaced to reduce deflection—permits high load-carrying capacity.

4 Splash system with large oil reservoir assures constant and thorough lubrication of all parts.

5 Anti-friction bearing construction throughout.

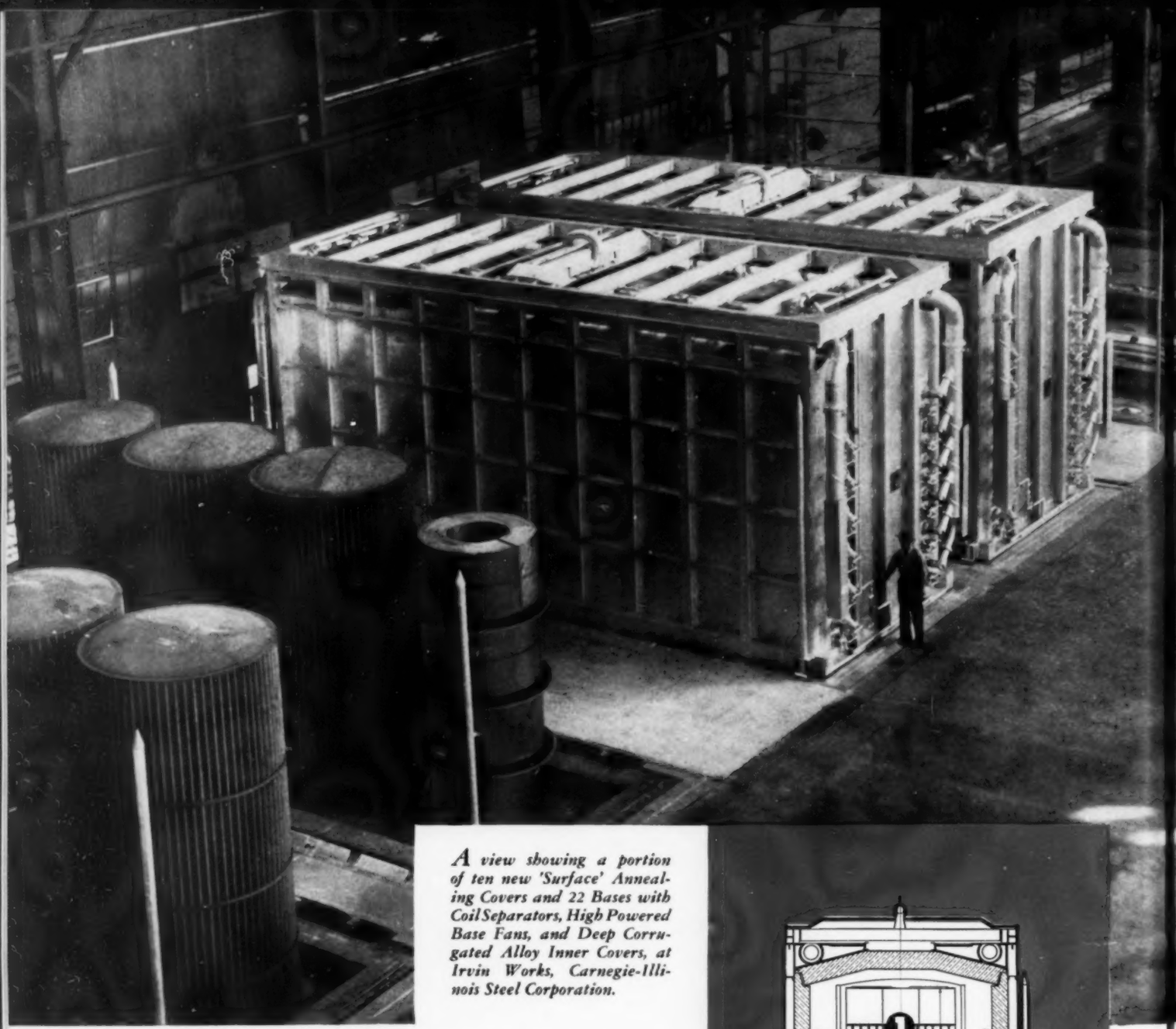
6 Reliance *Precision-Built* Motors provide the maximum in dependable and economical power. Types that may be had with GearMotoR are described in GearMotoR Bulletin C-404. Ask also for bulletins describing Reliance *Precision-Built* A-c. Motors—engineered for every power requirement.

Sales Representatives in Principal Cities

RELIANCE ELECTRIC AND ENGINEERING CO.

1084 IVANHOE ROAD • CLEVELAND 10, OHIO

"Motor-Drive is More Than Power"



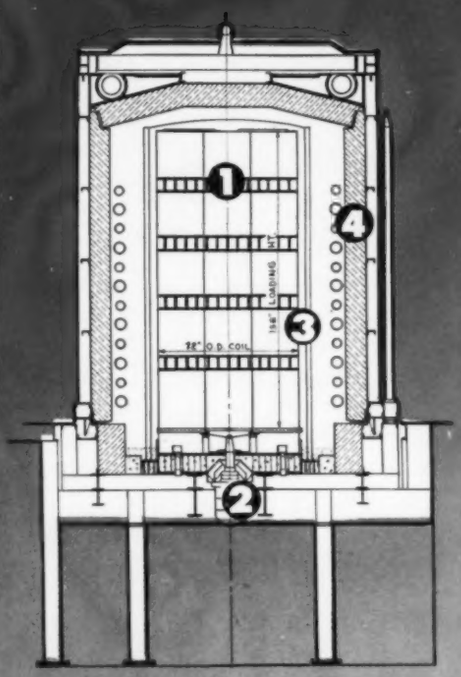
A view showing a portion of ten new 'Surface' Annealing Covers and 22 Bases with Coil Separators, High Powered Base Fans, and Deep Corrugated Alloy Inner Covers, at Irvin Works, Carnegie-Illinois Steel Corporation.

'Surface' SERVES WITH HEAT . . .

FROM INGOTS TO FINISHED PRODUCTS

• Hundreds of installations including Modern One-Way Fired Soaking Pits; Slab, Billet and Bloom Heating Furnaces; Continuous and Batch Normalizers and Annealers; Muffle and Radiant Tube Fired, Controlled Atmosphere Furnaces, and many other classes of furnaces, give outstanding evidence of 'Surface' acceptance *wherever heat is used in industry.*

It will pay to submit your heating and heat treating problems to 'Surface' Researchers and Engineers for up-to-the-minute recommendations and equipment.

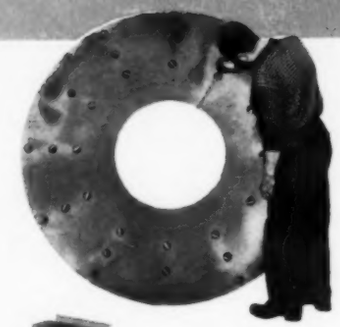


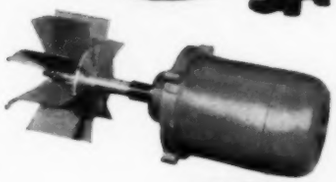
Cross section drawing of the 'Surface' Balanced Heat Flow System with the elements in working position.

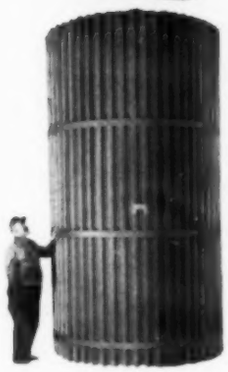
SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

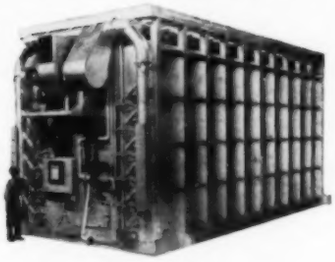
Balanced HEAT FLOW

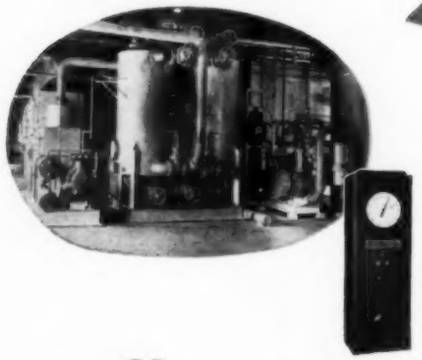
ANNEALS COILS FASTER AND BETTER











★ **Four new 'Surface' developments and improvements, used together in a balanced heat transfer system, are breaking records for speed and uniformity in strip coil annealing.**

1 **COIL SEPARATOR** • Of simple, rugged construction for balanced convection heating and cooling. Directs rapidly circulated heating and cooling gases to the ends of the coil laminations thereby utilizing solid metal heat transfer, rather than conduction through laminations.

2 **HIGH POWERED BASE FAN** • 'Surface' design. Power input ten times greater than used formerly. Incorporates a unique method of sealing annealing atmospheres against differential pressures.

3 **CORRUGATED INNER COVER** • Deep corrugations absorb and transfer the heat to the circulated gases within the inner cover during the heating cycle and speed cooling of the charge by reason of the large area exposed.

4 **RADIANT TUBE HEATING COVER** • Stepped-up useful heat input of 'Surface' Radiant Tubes balances the fast heat absorption rate of the new deep-corrugated inner covers and fast heat transfer of base fans and coil separators.

Two additional 'Surface' developments assure 'Quality Control' of heat treated products.

5 **NX ANNEALING ATMOSPHERE GENERATOR** • Furnishes a gas atmosphere environment for the steel, producing the highest quality electrolytic tin plate. Tin plate annealed in 'Surface' NX Gas Atmosphere shows higher corrosion resistance, more uniform plating, and fewer plating defects.

6 **DEW POINT RECORDER** • Provides a constant reference of water content of the atmosphere annealing gas, and when used with an "atmosphere selector" the gases from as many as six different furnaces can be analyzed at predetermined intervals.

'Surface' COIL ANNEALERS

new, individual-generator drive on world's fastest strip mill gives increased flexibility, more "on-gage" tonnage!

engineered drive provides automatic speed adjustment between stands, constant strip tension, and accurate gage control—at 6200 fpm!

Seventy miles per hour! That's the record speed of a new G-E-equipped tandem cold-strip tinplate mill. To this fastest and heaviest mill of its kind in the world, the new G-E individual-generator drive brings increased flexibility and simplicity of operation, higher permissible rates of acceleration and deceleration, and a greater percentage of "on-gage" strip.

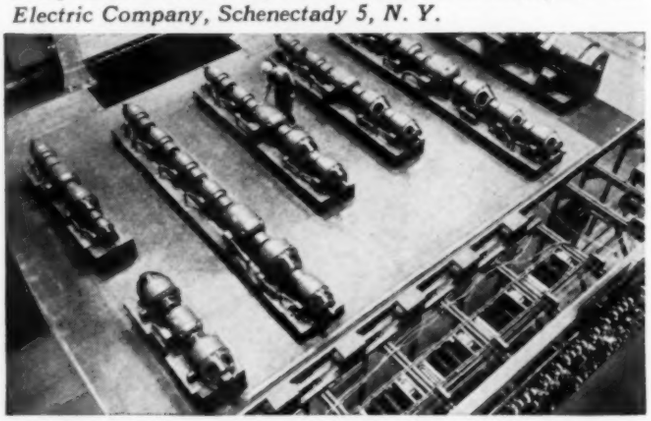
Widens Speed Range. By providing a separate generator for each drive motor, this improved drive eliminates the need for costly high-current series boosters and permits generator voltages to be adjusted independently of each other, thus widening the speed range of each stand.

Adjusts Tension Automatically. To hold proper speed relationship at all times between the stand motors, ohmic-drop compensation is provided by the G-E amplidyne. This electric "brain" automatically adjusts strip tension during acceleration and deceleration, thereby preventing strip breakage, possible damage to the mill rolls, and added scrap. The mill gets "on gage" faster, stays "on gage" longer.

Measures Gage by X-Ray. An X-ray thickness gage is another feature of the new drive. This unique device, without physical contact, continuously measures the finished strip's thickness, further insuring gage accuracy. In addition, tensiometers provide a continuous visual indication of strip tension.

Harnesses 16,800 hp. Six G-E drive motors have a total capacity of 16,800 hp. Use of twin drive motors on the last three stands prevents slippage between rolls and material, making for uniform strip quality and longer roll life.

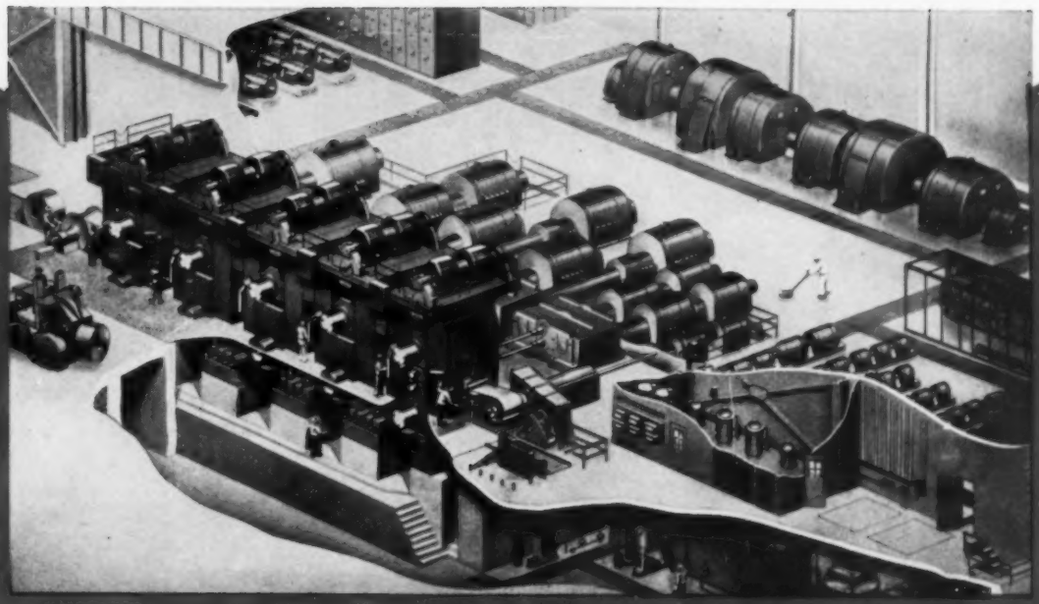
This individual-generator drive and its components, installed as a unit, is another example of General Electric's wide experience in engineering higher-speed, more accurately controlled steel mill drives. Whatever *your* drive problems, a G-E steel mill specialist will gladly discuss them with you and your own technical personnel. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



With G-E amplidynes, shown above, the new mill can be accelerated from a 300-fpm threading speed to over 4500 fpm or decelerated from 6200 fpm to a dead stop—in only 6 seconds!

GENERAL ELECTRIC

659-53



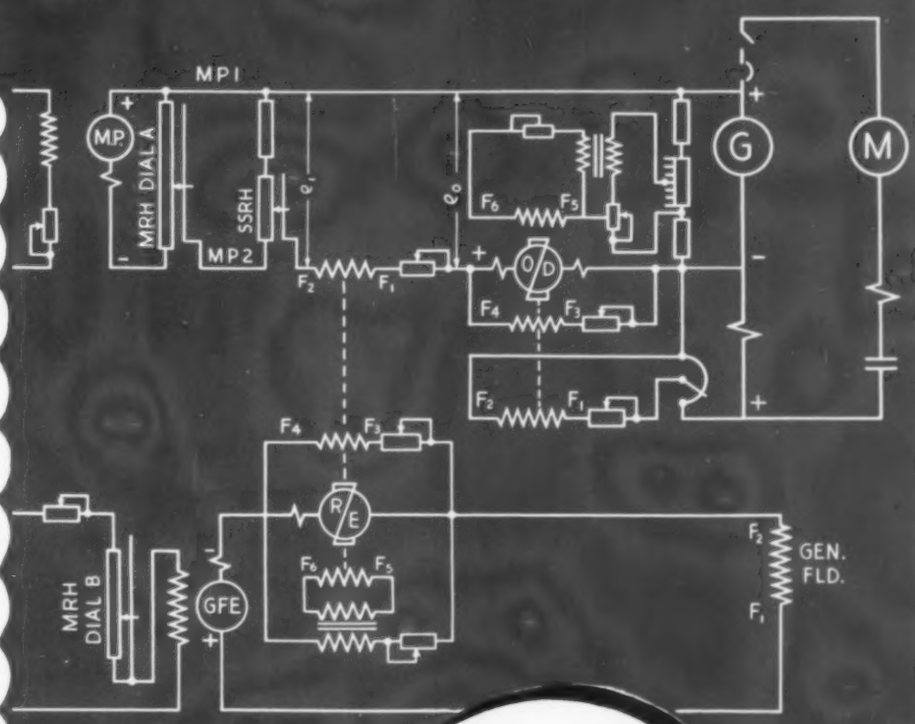
Complete electric equipment supplied by G-E for this 42-inch, 5-stand tandem cold-strip mill includes main driving motors (center), main m-g sets (rear), screw-down m-g set and 440-volt power distribution (left background), auxiliary m-g set and main control board (right center).

Here is how individual-generator control works on a single mill stand

In the control circuit shown on the right, the mill master rheostat determines the voltage on the master voltage-control bus MP1 and MP2, which is the standard by which the voltage on every generator is controlled. By raising or lowering the voltage on this bus, the voltages of all the generators may be raised or lowered proportionately. The mill master rheostat also controls the excitation on the generator-field exciter GFE which supplies all stand generators. In this way, regulating exciters RE on each stand can operate at low voltage levels ideal for fast regulator action.

Individual voltage adjustment on each generator is determined by the stand master rheostat. Each stand-motor speed can also be controlled by adjustment of its shunt-field current.

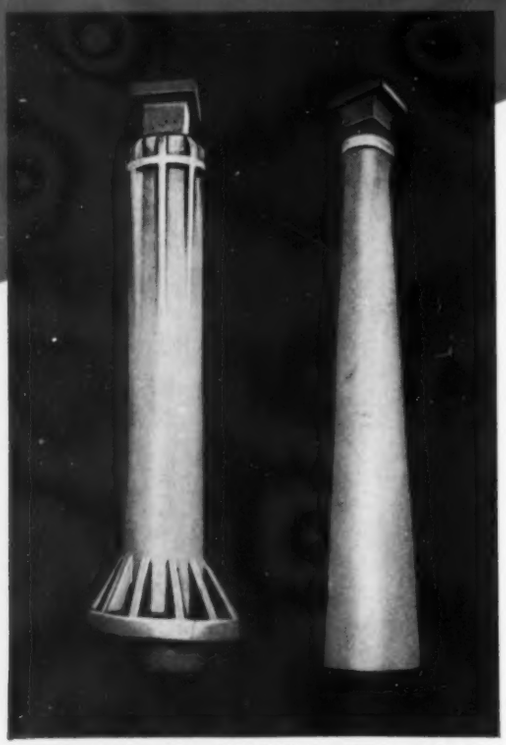
The ohmic-drop exciter OD receives its excitation from the voltage drop across the generator commutating field, and its output voltage may be made equal to (or any fixed percentage of) the motor-armature-circuit IR drop. The voltage of this amplidyne is automatically subtracted from the generator terminal voltage. Each stand regulator, through its regulating exciter RE, then acts to hold essentially motor cemf which is directly proportional to motor speed.



another example of GE drive engineering at work!

FOR HOTTER FUELS

BIGGER LOADS



UNION ALLOY STEEL PEELS

Except for the charge itself, no piece of unprotected metal is subjected to greater heat for a longer time than the peel. And, hot or cold, it must withstand severe shock and stresses as well. "Union" has developed for this tough service peels of heat and shock resistant alloys in designs that add months to their useful life. ... Glad to quote from your specifications on either rough or fully machined castings.

UNION DOUBLE LIFE HEAD CHARGING BOXES

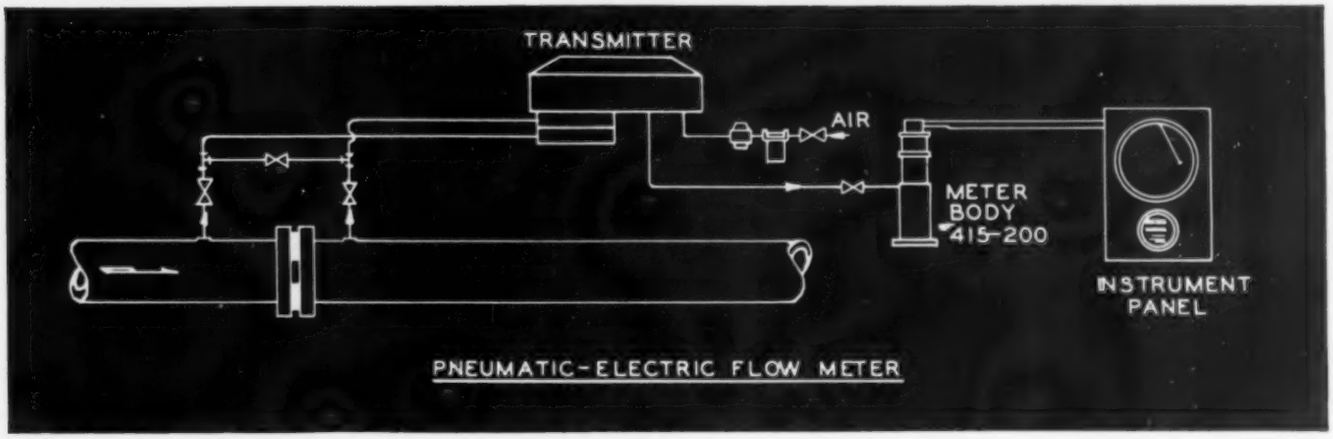
You'll be quick to see and appreciate the difference! That specially designed, reinforced head means "double life" without cracking or distortion ... All square corners have been replaced by round ones which lend themselves to better casting process ... Union Boxes are cast from UNIVAN—a special nickel-vanadium steel that maintains its superior strength under extreme conditions of heat, cold and shock ... Whether you operate with 20, 25, 36 or even 50 cu. ft. capacity charging boxes, we welcome the opportunity to prove that you can do a faster charging job for a longer time at less cost with Union Double Life Head Boxes ... Your request for further details and prices will receive immediate attention.

"UNIVAN" That Tough Steel

UNION STEEL CASTINGS

DIVISION OF BLAW-KNOX CO., PITTSBURGH, PA.

Cinder Pots • Slag Pots • Coupling Boxes • Spindles • Gears • Bells and Hoppers • Ingot Cars • Charging Cars • Annealing Boxes and Bases



The Answer to Your **OXYGEN** *Metering Problems!*

Here is an oxygen flow metering system that will accurately integrate the rapidly fluctuating flows encountered in steel mill operations.

CONTINUOUS INTEGRATION

The electric integrator, operating on a modified watt hour principle, is continuous, not intermittent in operation — is extremely sensitive, acceleration and retardation being practically instantaneous. It will accurately integrate the most erratic fluctuations transmitted by the highly responsive meter element.

SENSITIVE METERING SYSTEM

The flow metering system, shown diagrammatically above, is a combination pneumatic-electric system for measuring a rapidly fluctuating flow. It consists of a pneumatic transmitter, an electric meter body and any desired combination of remote reading instruments. It has been especially designed to overcome the problems encountered in oxygen flow measurement.

Republic Continuous Integrator

FIELD TESTS

Laboratory tests of the complete meter have shown an over-all accuracy within ±2% for various flow cycles, including a cycle as short as 8 seconds "on" and 8 seconds "off". Field installations checked against weighed quantity of oxygen actually delivered over six month period substantiate these laboratory tests.

WIDE RANGE

For those installations where wide ranges of flow are encountered, a Republic pneumatic-electric metering system can be installed with a range of approximately 10 to 1. By a special piping arrangement, the range of accurate flow measurement can be extended to approximately 50 to 1.

The Republic pneumatic-electric flow metering system is completely described in Bulletin No. 48-2.

Write for your copy today.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

Q **IS ALUMINUM RECOMMENDED for BIG PLANTS?**

A **ALUMINUM** gives you your biggest savings where loads and conductors are large.

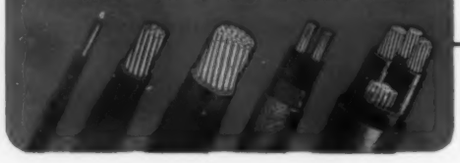
Insulated wire and cable with Alcoa E. C.* Aluminum conductor can deliver power where you need it, at lower cost. Your savings on cable and wire can amount to thousands of dollars on a single job.

Aluminum cable is lighter, too—approximately half the weight of copper, or less, in bigger sizes. That means easier installation and lower transportation costs.

Alcoa makes light, strong, conductive E. C. Aluminum. Leading wire and cable manufacturers draw, strand and insulate it, and sell it under their own trade marks. Ask your wire supplier about it, or write ALUMINUM COMPANY OF AMERICA, 2128 Gulf Building, Pittsburgh 19, Pennsylvania.

*E. C.: *Electrical Conductor* Aluminum

Insulated and sold by leading wire manufacturers



ALCOA EC ALUMINUM

FOR ELECTRIC WIRE AND CABLE

Rolls with the punch... on TIMKEN® bearings

TO carry the tremendous impact on the thrust block, with minimum friction and wear, Aetna Standard Engineering Company uses Timken® bearings at this important point in their 26″ piercing mill, as well as in the piercer drive and roll necks.

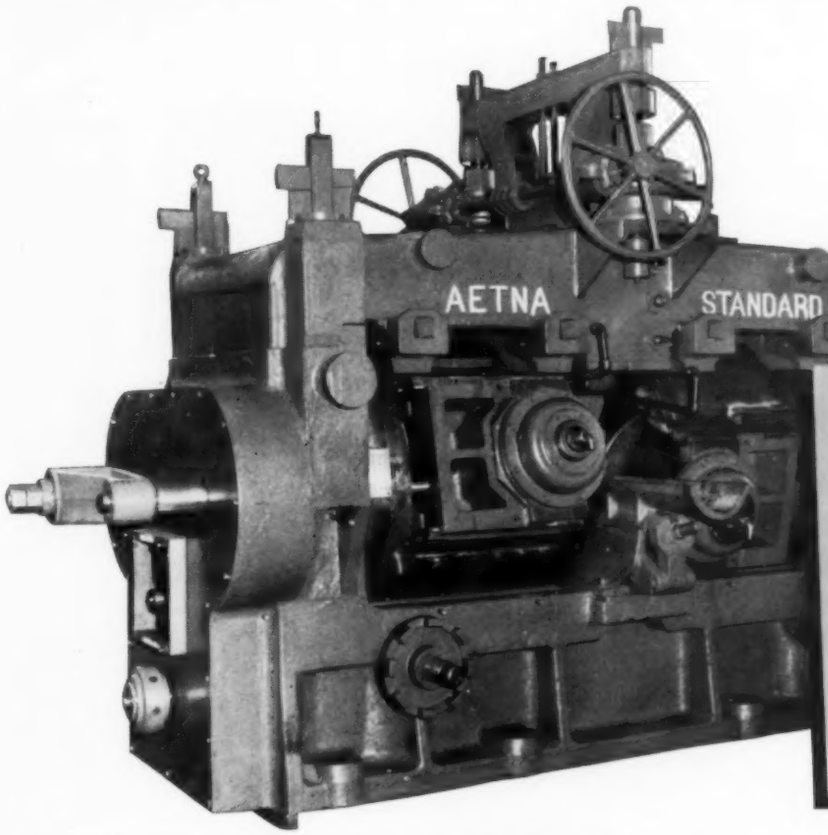
Lubrication is simplified, thrust block rigidity is increased, and stoppages due to bearing trouble are eliminated.

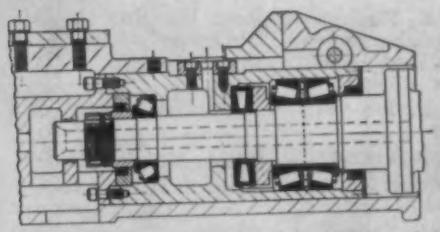
Timken bearings are made from the finest steel ever developed for tapered roller bearings . . . Timken fine alloy steel. Due to the line contact between rolls and races, Timken bearings have tremendous load carrying capacity. They normally last the life of the machine in which they are used.

The tapered construction of Timken bearings enable them to carry any combination of radial and thrust loads. Their true rolling motion and incredibly smooth surface finish assure minimum friction.

Over the years, the dependable performance and public acceptance of Timken bearings have made Timken-equipped products first choice throughout industry. Timken bearings help build greater preference for your product among customers. When you specify bearings, specify "Timken". And when buying new equipment, make sure it is Timken-equipped. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This label on a product means its bearings are the best.





How AETNA STANDARD ENGINEERING CO. *uses Timken bearings in thrust block of 26″ piercing mill. Three Timken bearings are used in the thrust block, 8 in the piercer drive, and 4 on the roll neck.*

TIMKEN BEARING CAPACITY RATINGS INCREASED 25%.

Since Timken bearings were last re-rated some 15 years ago there has been such a further and constant improvement in quality that we are now able to announce a 25% increase in radial and thrust load carrying capacity. This may make possible the use of smaller bearings with savings in bearing cost, material cost and weight. Engineers will be able to utilize the advantages of Timken bearings in more applications than in the past.

A new Timken Engineering Journal, now in preparation, will give you complete capacity rating tabulations. For further assistance, write us today.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ⇩ AND THRUST →◫← LOADS OR ANY COMBINATION ✳

You can depend on

"OPERATIONAL EXPERIENCE"

The design-engineer of rolling mill equipment should know rolling practices and problems from A to Z. It's the *operational experience* Lewis engineers possess that determines the design of Lewis Rolling Mills and related machinery . . . Results—Simplicity, Productivity and Economy of maintenance.

We welcome the opportunity to discuss ways and means of increasing your capacity and profits.

LEWIS MAKES

Beds—Cooling

Blanks—Gear • Pinion

Boxes—Coupling

Castings—Rolling Mill Furnace

Coilers—Ferrous and Non-ferrous Strip

Gear Drives

Gears and Pinions—Bevel • Double Helical • Single Helical • Speed Reduction • Spur

Housing Pinion—Rolling Mill

Lathes—Roll Turning

Levelers—Roller for Plate and Sheet

Machinery—Special • Flaking Mill • Rolling Mill

Machines—Pickling

Manipulators—Rolling Mill

Mills—Aluminum Foil • Bar • Billet and Blooming • Brass and Copper • Cold Rolling • Continuous • Edging • Four-High • Single Stand • Reversing and Tandem • Merchant • Plate Rolling • Precision • Sheet and Strip • Slabbing • Three-High • Tin Plate • Universal • Wire • Zinc Strip • Roughing and Finishing

Reels—Tension

Roll Ragging Attachments

Roll Polishers

Rolls—Alloy Iron • Chilled Iron • Sand and Chilled Iron • Steel

Saws—Hot and Cold

Screwdowns—Motor Operated • Hand Operated

Shears—Alligator • Bar • Billet • Bloom • Continuous Automatic • Sheet Mill • Gate or Guillotine • Lever • Plate • Power Driven • Scrap • Vertical

Straighteners—Angle • Bar • Rails and Shapes

Tables—Blooming Mill • Rolling Mill Feed • Transfer for Mills

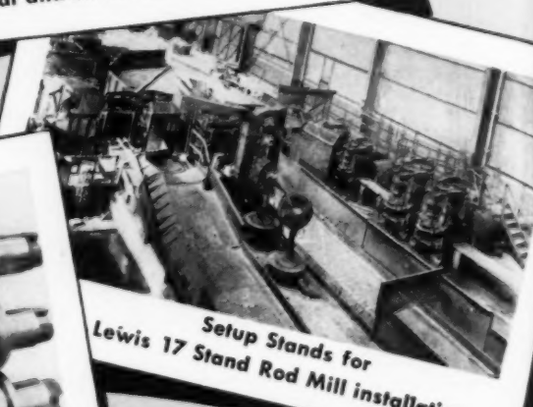
LEWIS FOUNDRY & MACHINE
Division of Blaw-Knox Co.
Pittsburgh, Pa.

Designers and Builders of Rolls and Rolling Mill Equipment

Lewis 17 Stand Rod Mill, view at finishing end

Lewis Three-High Jump Mill and Tables

Lewis Bar and Structural Mill Stand



Setup Stands for Lewis 17 Stand Rod Mill installation

Lewis Ajax Rolls (High Alloy Grain Type)

LEWIS ROLLING MILL EQUIPMENT

PRODUCT Information

ON ANY OF THE PRODUCTS MENTIONED IN THIS ISSUE

Below is an index of products referred to in editorial and advertising pages of this issue. If you desire additional information on any of them, use one of the accompanying postcards in requesting it. In each case give name of product and page number. The information will come to you directly from the manufacturer involved.

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IRON AND STEEL ENGINEER October, 1948

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1010 EMPIRE BUILDING

PITTSBURGH 22, PA.

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IRON AND STEEL ENGINEER October, 1948

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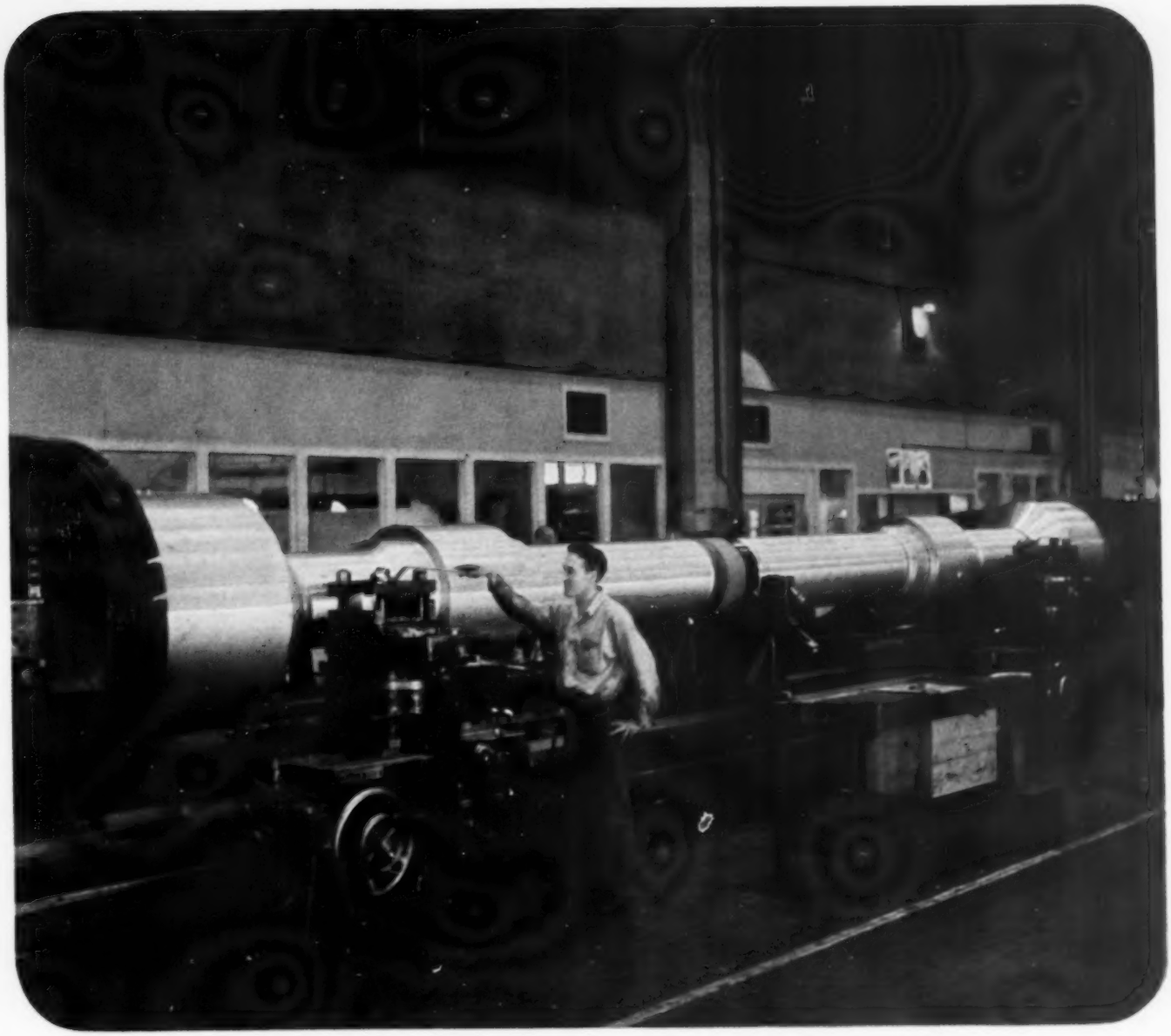

33 Foot Blooming Mill Spindle in Lathe—New Castle, Pa. plant.

Designed UE&FCO REG. T. M. *and Built by*

UNITED ENGINEERING and FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at Pittsburgh, Vandergrift, New Castle, Youngstown, Canton
Subsidiary——Adamson United Company, Akron, Ohio
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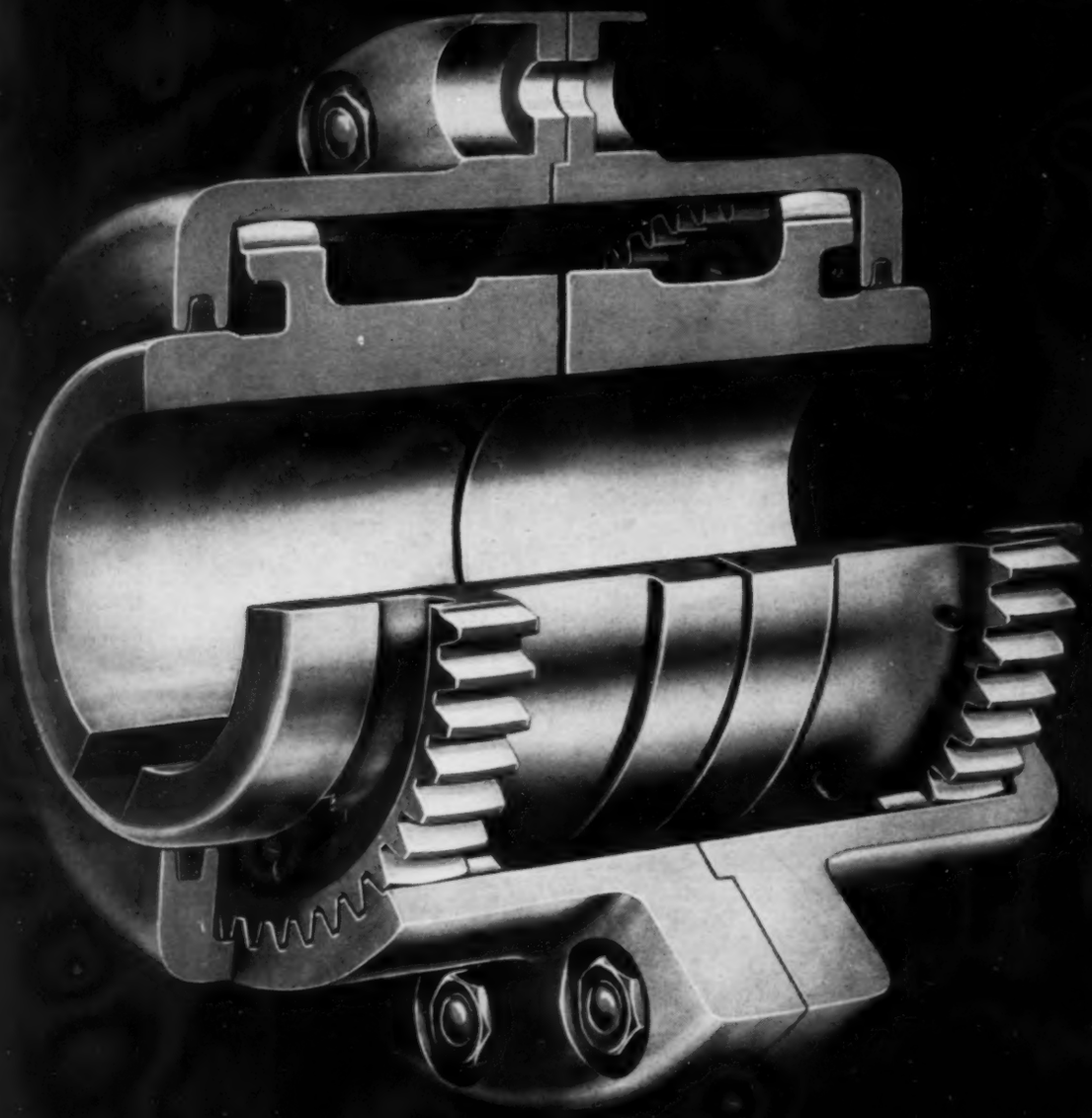
Designers and Makers of Rolls and Rolling Mill Equipment

POOLE

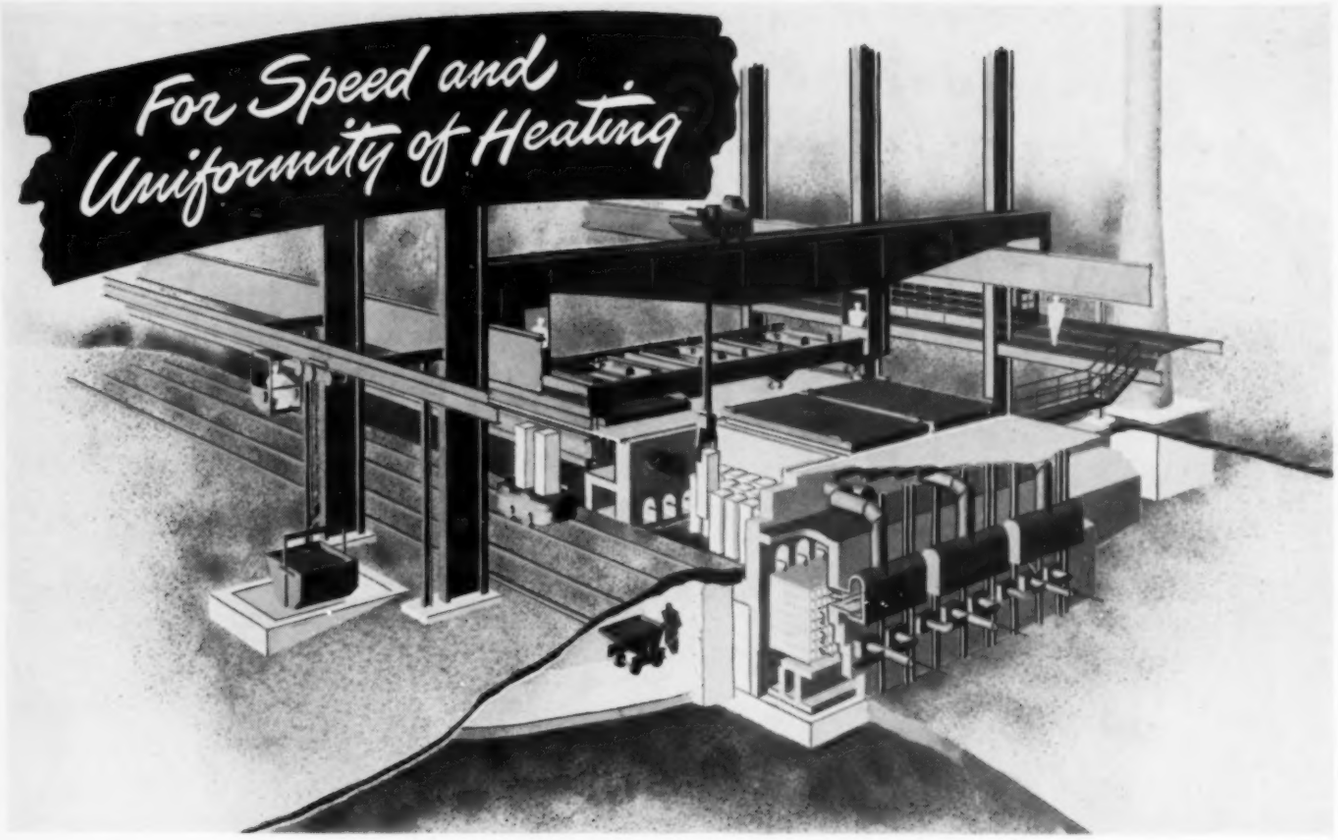


A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

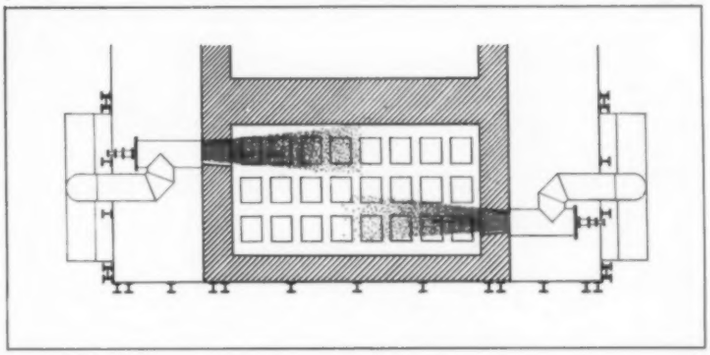
WOODBERRY, BALTIMORE, MD.

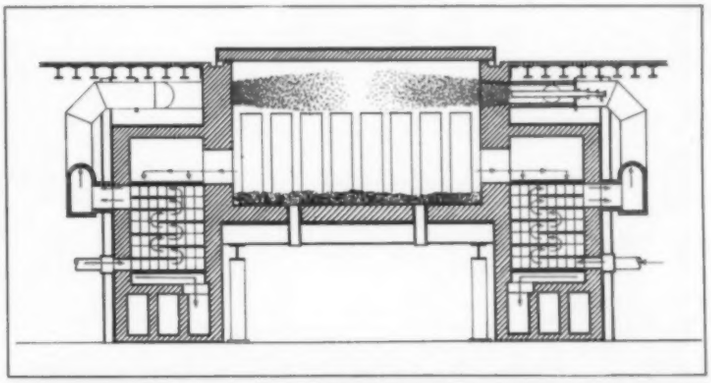


RUST CONTINUOUS-FIRED SOAKING PITS

Two-way top fired ▲ Completely automatic ▲ Recuperative type ▲ All fuels

THE RUST continuous two-way fired soaking pit offers increased efficiency with increased economy. It utilizes the otherwise wasted upper portion by employing the diagonally top fired principle. Provides increased charging capacity per square foot of area, better heat distribution, and less radiation surface per ton charged. Absence of flame impingement increases refractory life of walls and covers. Design permits construction in batteries of two or more holes.





THE WHOLE JOB IS ONE JOB WITH A "RUST PACKAGE CONTRACT"

ONE RUST CONTRACT covers everything . . . from blueprint to test-run. Rust assumes responsibility for design, manufacture and erection of all essential material . . . including excavations, foundations, wiring and piping. Your purchasing and engineering departments are freed of subcontractor headaches when you order from Rust.

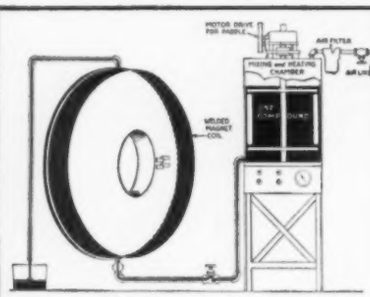
RUST FURNACE CO.

PIONEERS IN FURNACE DESIGN

PITTSBURGH, PENNSYLVANIA

ELECTRICAL ENEMY No. 1
Conquered by TYPE "SW" All Welded Lifting Magnet

Not a *Single Case* of Moisture in Magnet-Winding

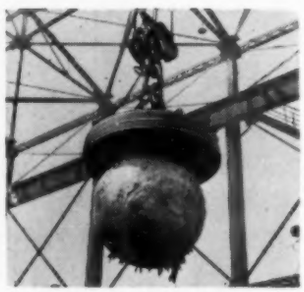


Longer Magnet Life, because –

1. Coil is jacketed in a welded steel case after winding.
2. Heated to drive out all moisture.
3. Filled with EC&M No. 282 compound —bottom filling eliminates air pockets.
4. Compound is thermally set by baking—provides a stable but resilient insulator between winding and case—does not melt nor become brittle.
5. Coil-case is sealed into magnet-housing by continuous welds. A water-tight coil within a water-tight housing gives double protection against moisture.

The problem of preventing moisture entrance into the magnet-winding has been mastered in the EC&M Type "SW" *All-Welded* Lifting Magnet. Hundreds of these *all-welded* magnets have been operating under all kinds of climatic conditions and there has *not* been *one* case of moisture in the coil-winding.

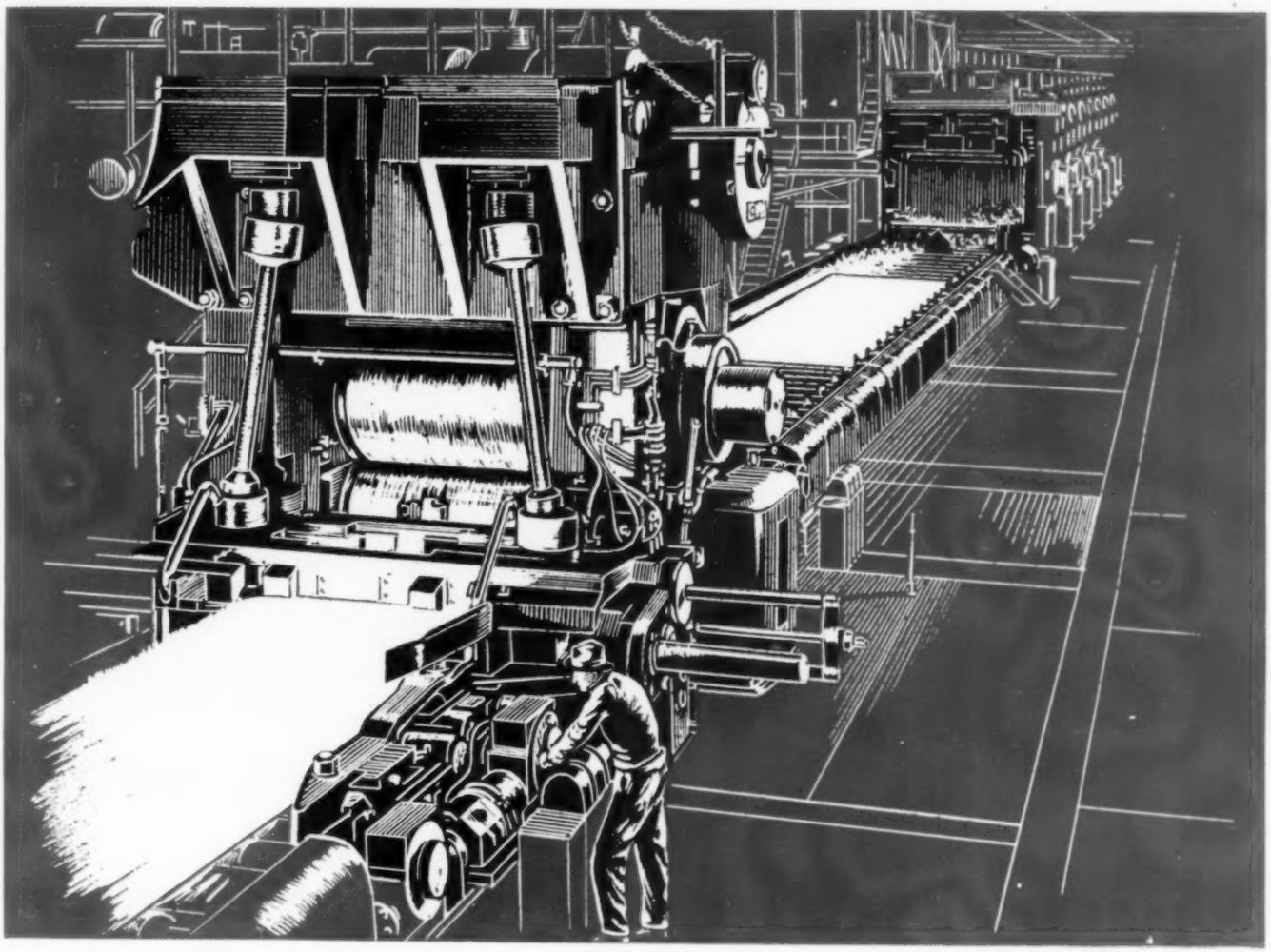
Lifting Magnet's Enemy No. 1 has *lost*. This destroyer of insulation, this promoter of grounds and shorts has been soundly whipped. Only EC&M's Type "SW" Magnet is completely welded for permanent protection. Ask for Bulletin 900 describing this advanced lifting magnet design.



E&M

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

YES! Tycol Apreslube Lubricants perform better . . . BETTER . . . BETTER



Tycol Apreslube Lubricants perform better because:

. . . *Tycol Apreslubes* are high quality oils, blended to assure maximum heavy duty lubrication.

. . . *Tycol Apreslubes* resist corrosion, even in the presence of moisture.

. . . *Tycol Apreslubes* will not separate while in storage or service.

. . . *Tycol Apreslubes* are engineered to "take it" without thinning down and dripping out, keep bearings . . . pistons . . . gears friction-free and cool.

For more information on Tycol Apreslubes and the other Tycol industrial "engineered" lubricants, write your nearest Tide Water Associated Office.

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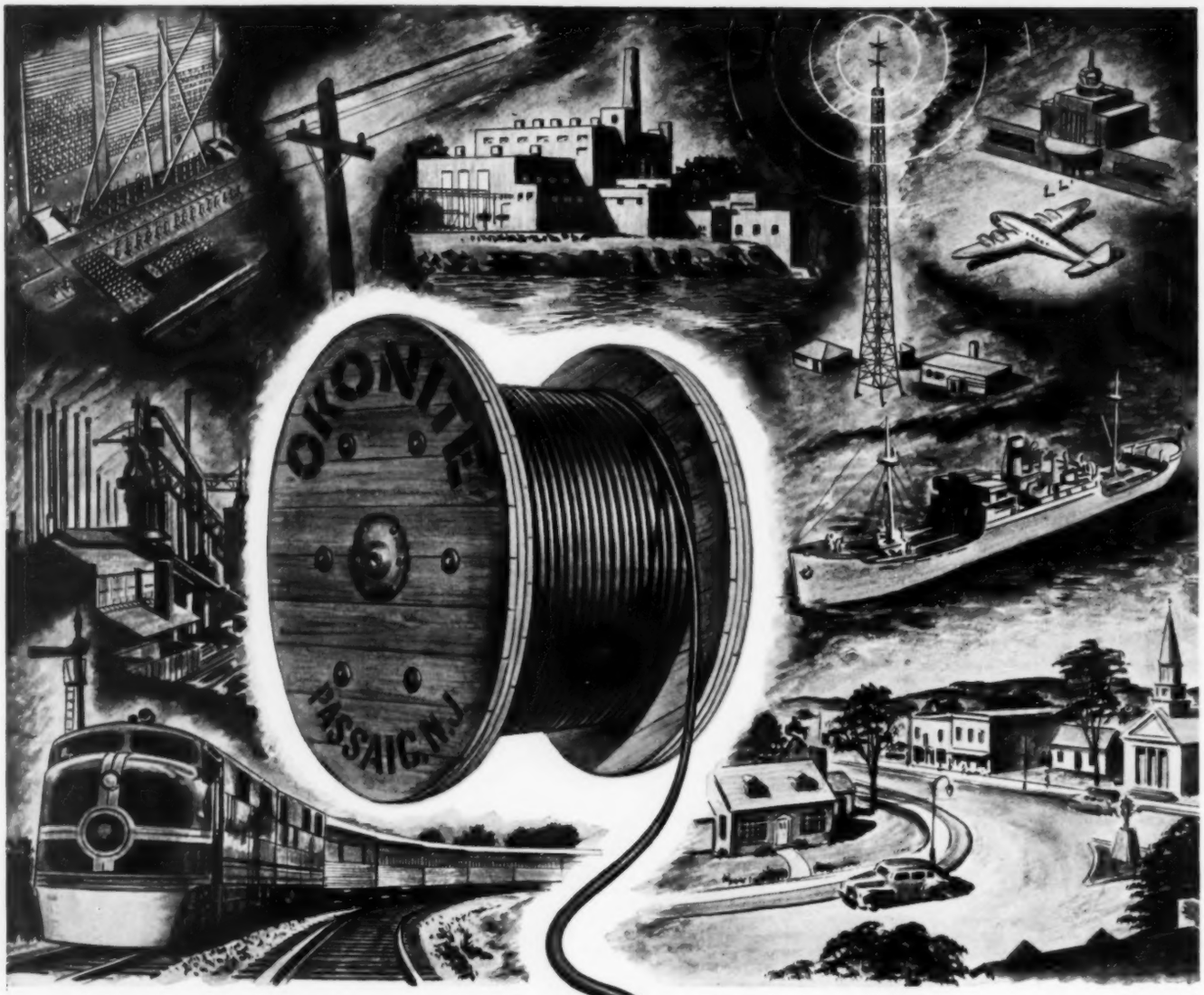
LUBRICATION — "ENGINEERED TO FIT THE JOB"



WHEREVER THEY SERVE— LOOK FOR LONG LIFE

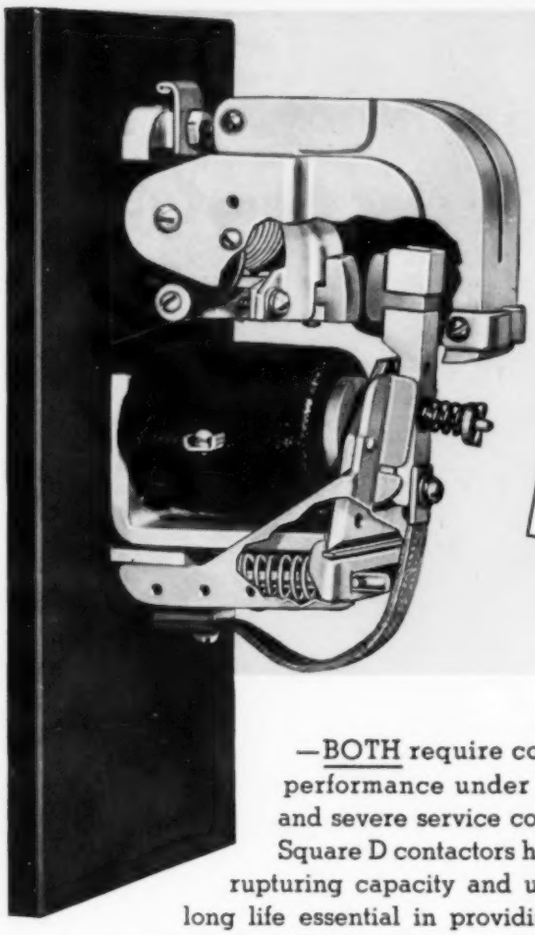
In today's many-sided industrial picture . . . with today's installation costs, only the longest-lived wires and cables are economical. Okonite wires and cables, built to stand up better and longer, offset high installation costs.

In realizing this goal, there are many "musts" for Okonite. Up-river fine Para rubber, for example, goes into Okonite cable insulations because it provides *all* needed factors. Okonite's strip insulating process is used because it assures perfect centering of conductors. Vulcanizing is done in a continuous metal mold so that every foot of cable gets uniform treatment — a practice that's standard only with Okonite.

In addition to a-c tests, Okonite subjects its cable to high voltage d-c tests more severe than used by any other cable manufacturer. Long time heat runs prove the stability of Okonite insulations. And these tests are checked not only by the accelerated-aging oxygen bomb, but by the slow, sure, year-after-year weather exposures made in Okonite's proving ground —a permanent outdoor cable laboratory. For detailed descriptions of Okonite "musts," write for your copy of illustrated 32-page Research Bulletin IS 101. The Okonite Company, Passaic, New Jersey.

OKONITE OKONITE SINCE 1878 **insulated wires and cables**

THE BEST CABLE IS YOUR BEST POLICY



Square D HEAVY DUTY D.C. Contactors are used on BOTH Mill Auxiliary and Accessory Machine Control Panels Because...

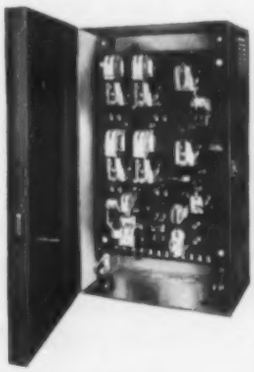
—BOTH require consistent performance under difficult and severe service conditions. Square D contactors have high rupturing capacity and unusually long life essential in providing uninterrupted production. Low inertia moving parts, knife edge bearings and strong blowouts contribute to fast operation necessary for both mill auxiliary and accessory machine control. Another important advantage—the problem of stocking spare parts is minimized through use of the same heavy duty construction.

Although identical contactors are used for both mill auxiliary and accessory machine control, the real difference in completed panels is governed by variations in assembly and construction features listed in the table below.

Write for information on Classes 7735, 7736, and 7950 Heavy Duty D. C. Control. Square D Company, 4041 N. Richards Street, Milwaukee 12, Wisconsin.

FEATURES	MILL AUXILIARY CONTROLLERS	ACCESSORY MACHINE CONTROLLERS
Heavy duty contactors	X	X
Negative line contactor	X	
Accelerating contactors —with blowout	X	
—without blowout		X
Heavy duty control relays	X	Available
Heavy duty shunt field relays	X	X
Pneumatic timers for acceleration	X	X
Overload relay 2 THERMAL-MAGNETIC	X	
1 melting alloy thermal trip		X
Terminals —mounted rear of panel	X	
—mounted front of panel		X
Main line knife switch	X	
Control knife switch	X	
Control circuit fuses	X	Available
Heavy gauge sheet steel enclosures	X	X
Vault type door mechanism	X	Available
Enclosure removable back plate	X	

Class 7951 Reversing, Dynamic Braking Control for Mill Auxiliaries.



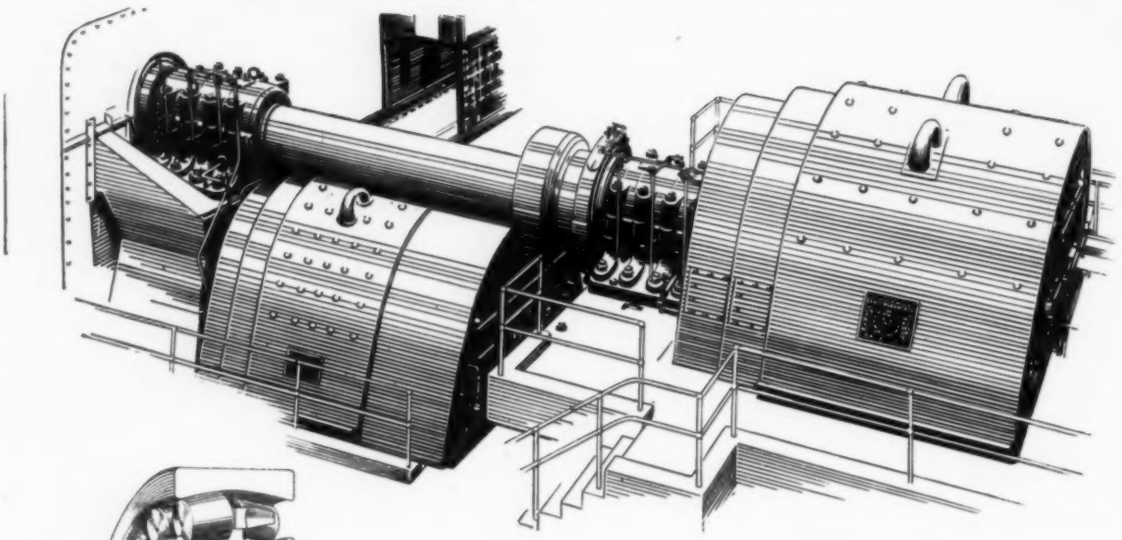
Class 7736 Reversing, Dynamic Braking Control for Accessory Machines.

SQUARE D COMPANY

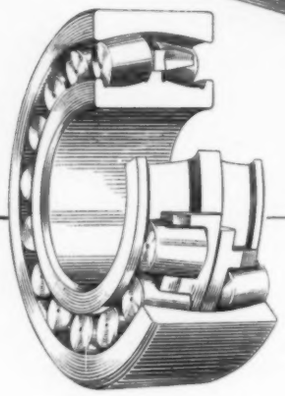
DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

Gear Drives Mesh Smoothly with Torrington Spherical Roller Bearings



Steel mill gear drives equipped with Torrington Spherical Roller Bearings operate at higher speeds under heavier loads with maximum accuracy, minimum wear.



...these self-aligning units carry thrust in both directions, preventing end-play of shafts, assuring accurate meshing of gears.

Steel mill gear drives equipped with Spherical Roller Bearings transmit power smoothly – with minimum wear of bearings and gears.

The low friction coefficient and precision construction of these heavy-duty bearings insure smooth operation. Automatic compensation for misalignment prevents undue stress of bearing elements under shaft deflection. Because of the high radial capacity and ability of Spherical Roller Bearings to carry thrust loads in either direction a minimum of maintenance attention is required.

Torrington Spherical Roller Bearings are providing longer service life in many types of steel mill auxiliary equipment such as gear drives, pinion stands, table rolls, coilers, reels, tension rolls, screw downs, truck wheels and cranes.

Let a Torrington engineer make recommendations on selection and design of anti-friction bearings for your heavy-duty equipment. Call or write the nearest Torrington office.

THE TORRINGTON COMPANY

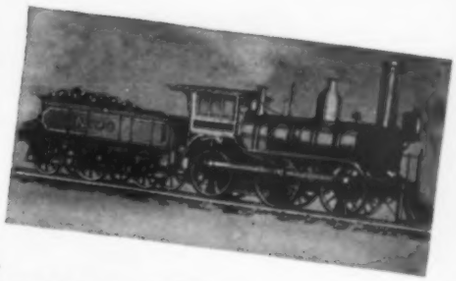
South Bend 21, Ind. • Torrington, Conn.

District Offices and Distributors in Principal Cities

TORRINGTON *SPHERICAL ROLLER* **BEARINGS**

SPHERICAL ROLLER · TAPERED ROLLER · STRAIGHT ROLLER · NEEDLE · BALL · NEEDLE ROLLERS

ROLLS FOR RAILS



RAIL ANCESTRY

1630—Newcastle, Eng.—Wooden rails protected at curves and on grades by thin malleable iron plates.

1737—Whitehaven, Eng.—Continuous cast iron strips on wood stringers.

1767—Coalbrookdale, Eng.—Cast iron edge rails.

1776—Coalbrookdale, Eng.—Cast iron flange rails.

1789—Derby, Eng.—Jessop cast iron fish belly rail for flanged wheels.

1825—Stockton & Darlington R.R., Eng. —Birkinshaw rolled iron fish belly rail.

1831—Camden and Amboy R.R., N. J. —First "T" rails.

1833—Allegheny Portage R.R., Pa.— Clarence rail.

1834—Baltimore and Ohio R.R., Washington branch—"H" or double-headed rail.

1844—Mt. Savage, Md.—First iron "T" rails rolled in America.

1865—First Bessemer steel rail rolled in this country by Captain Ward's North Chicago Rolling Mills.

1867—Johnstown, Pa.—First steel rails rolled "in the course of regular work" in America.

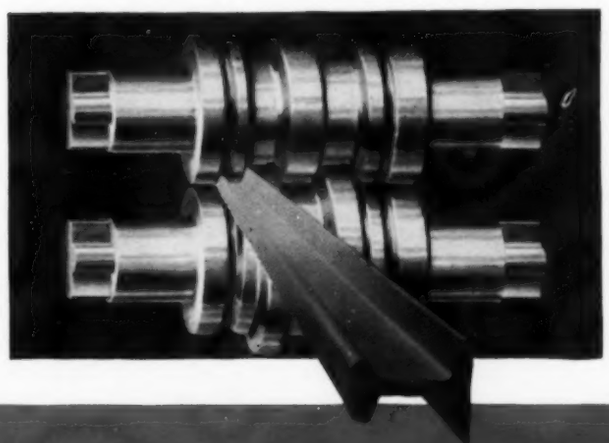
Modern rail mills use and like these Phoenix rolls:

For roughing stands: Phoenix "A" Alloy Steel.

For intermediate stands: Phoenix Metal and Phoenix "K" Alloy Iron.

For finishing stands: Phoenix Special Rail Finishing Alloy Iron cast in special chill flask equipment so penetration of hardness in the roll will reach the bottom of the flange. This assures longer roll life, smoother rail flange surfaces, and *less cost per ton of rails rolled.*

PITTSBURGH ROLLS
Division of Blaw-Knox Company
PITTSBURGH 1, PENNSYLVANIA



SEND for Catalog No. 2090 giving recommended rolls for all types of mills.

PITTSBURGH ROLLS

P.R.W

GET THIS NEW

Bulletin

. . . IT'S FILLED WITH

FACTS YOU'LL WANT

ON **QUALITY HEATING**

Important Data on the
Urquhart Combustion Process
for Industrial Furnaces
HOW THE PROCESS FUNCTIONS
FORGE FURNACE APPLICATION
SOAKING PIT APPLICATION
URQUHART PROCESS CAN BE APPLIED TO YOUR PRESENT FURNACES WITH MINIMUM CHANGES

Just off the press—the most factual information available on the Urquhart Combustion Process—giving actual case histories and the things you'd like to know. Write today for your free copy.

STEEL PROCESSING COMPANY

FORT PITT BRIDGE WORKS SUBSIDIARY

PITTSBURGH, PA.

Would You Like 100 Tireless Hand·Chippers For Your Billet·Shed?

IT'S A MAN·KILLING JOB . . .

LET THE BILLETEER DO IT...

One hand chipper can remove a 12" chip in 60 seconds of ear-splitting, grueling work, whereas . . .

A Bonnot Billeteer operator removes a 12" chip in 2 seconds, as the 45-ton machine responds to his finger-tip control. Electric and hydraulic power activates the carriage, roll-table, chucking, turn-over, feed and turnout units. There's practically NO OPERATOR FATIGUE—no let-up in the steady output.

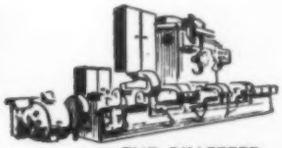
Safety-wise, a recent survey revealed that in 490,000 Billeteer hours of operation, only one man was involved in a disabling accident—A TRULY-TERRIFIC BILLET-SHED SAFETY RECORD.

MEN LIKE TO OPERATE BONNOT BILLETEERS. They decrease employee turnover in your billet-shed and boost efficiency and output.

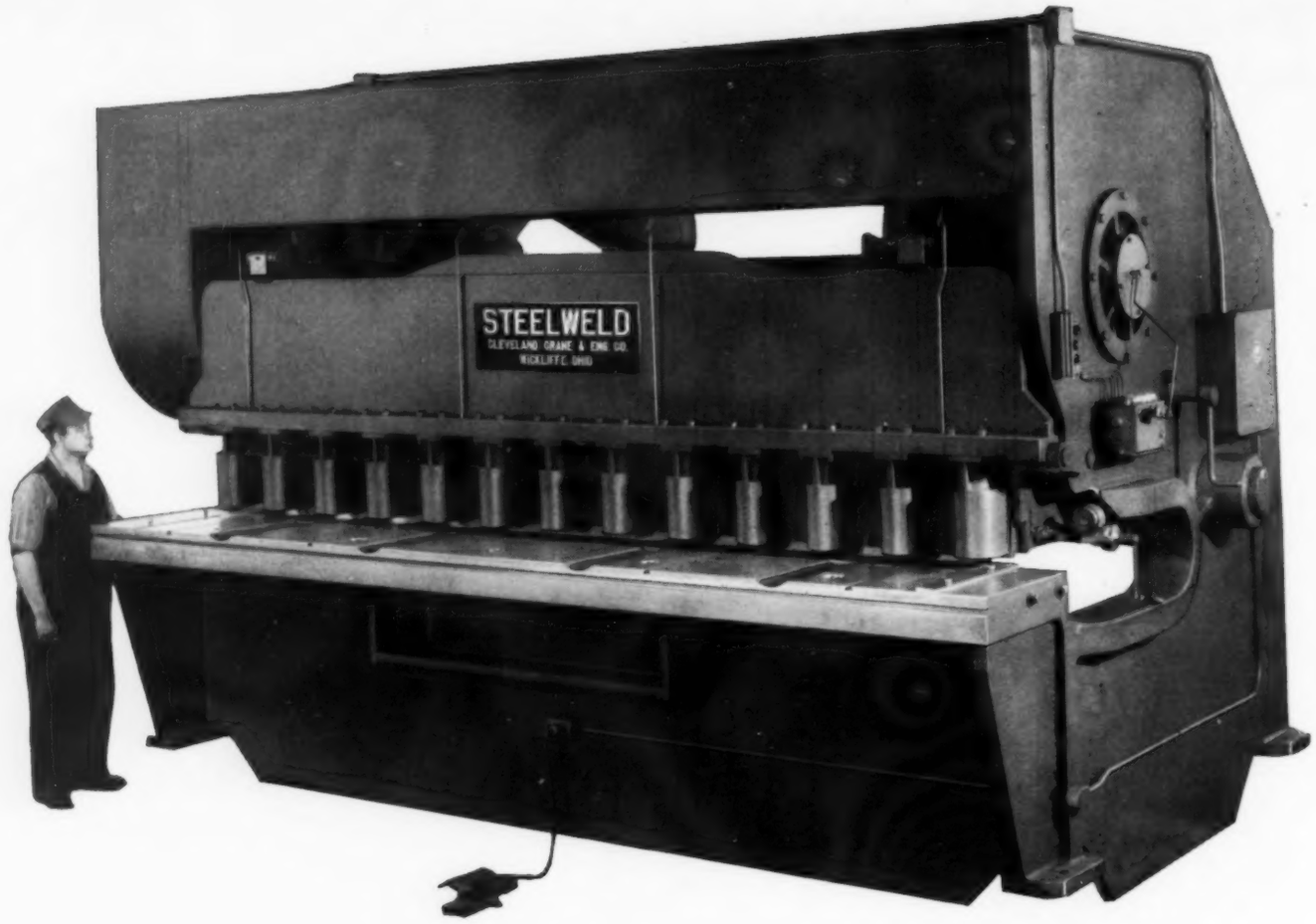
Write today for complete information. A Bonnot engineer will give your inquiry his personal attention.

Engineered for Improved Production

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO



THE BILLETEER



CUTS 12 FEET 3/4 INCH STEEL PLATE
at 30 Strokes Per Minute

SOME FEATURES OF THIS SHEAR

1. Cuts by pivoted-blade principle.
2. Operated by electric foot switch.
3. Knife clearance adjusted by hand crank and dial indicator.
4. 36-inch throat permits slitting wide plate.
5. Lift-up type back gauge on ball bearings.
6. Heavy all-welded one-piece steel frame.

This is one of a complete line of Steelweld Pivoted-Blade Shears that has been developed for cutting plate of all thicknesses from 12 gauge to 1¼-inch plate and for lengths from 6 feet to 18 feet.

Steelweld Shears are radically different from all other shears now on the market. They have features never before possible. The revolutionary pivoted-blade travels in a circular path and overcomes handicaps of ordinary guillotine-type shears.

Not only are these machines easier to operate but their design assures smooth straight cuts to hair-line accuracy for years of operation. Their construction is extra heavy, and all modern features are incorporated to provide for ease of operation, minimum maintenance and long life.

Get the facts on these outstanding machines.

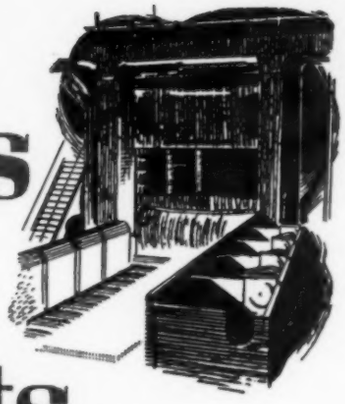
GET THIS BOOK!

CATALOG No. 2011 gives construction and engineering details. Profusely illustrated.

THE CLEVELAND CRANE & ENGINEERING CO.
1131 EAST 283RD STREET • WICKLIFFE, OHIO

STEELWELD PIVOTED BLADE SHEARS

Crops and Shorts



THE Federal Trade Commission is emphasizing the fact that no order of theirs ever called for f.o.b. prices. They say that basing points may be used if the action is done independently and if one customer is not favored more than another — and therein lies the hitch.

The Federal Trade Commission, in all its dealings, does not interpret its rulings ahead of time, but waits until the rulings are in effect and then brings suits where it believes the rulings are transgressed. Thus, businessmen cannot get a list of "do's and don'ts," but must proceed on his own judgment and hope to avoid court suits with their attendant expense and bad publicity.

Under these conditions it would be almost impossible to avoid suits for triple damages brought by customers who felt they were being discriminated against. Hence, basing points were abandoned. Complaints about the elimination are flowing rapidly to Senator Capehart's subcommittee, and it is possible that legislation legalizing basing points — or at least clarifying the present confusion — will be forthcoming.

▲

NATIONAL income during the second quarter of 1948 rose to an annual rate of $221 400,000, an all-time high.

▲

A NEWS columnist says a husband is a man who is spouse-broken, and one of our correspondents defines bachelors as men who have nobody to share the care they would have if they were married.

▲

FROM "Trumbull Cheer:" In this busy fast-moving world in which we live, hate is a luxury no one can afford . . . Hating, in reality, is a childish outlet for our emotions. It is an emotional display which helps no one and hurts everyone, the one who hates more than the one who is hated. The victim is hurt only on those few occasions when he is unfortunate enough to come into contact with the one who hates. But to the latter, hate is like a shadow — it is with him all the time . . . Truly, today more than ever, there is no time to hate!

▲

HAVE you noticed that it is harder to make ends meet since we are trying so hard to make week-ends meet?

EXPENDITURES for plants and equipment in all industries in the United States is running at a rate of $18,300,000,000 per year, almost 10 per cent above last year.

▲

INTENT on reducing the family food budget, a housewife we know tried out a no-egg, no-butter, no-sugar recipe. Her results — no cake.

▲

AMONG items now authorized for delivery abroad through the Marshall plan is $27,000,000 worth of iron and steel, approximately two-thirds of which is to be supplied by the United States.

▲

IDENTICAL measures have been introduced in both branches of Congress providing that the Treasury Department peg the prices of silver at $3.50 and of gold at $56 per Troy ounce. Here is the old 16-1 ratio of William Jennings Bryan, but at values considerably above even present prices. Some outstanding economists believe that such legislation would lead to catastrophe, both national and world-wide. We are not qualified to say yes or no to this, but our prejudices against pegged prices for anything and against any further cheapening of the dollar turn us "agin" the idea.

▲

BUREAU of Labor statistics show that only 46 per cent of United States workers are employed in actual production. The other 54 per cent are in service industries. The statistics also show that domestic service and personal service take about the same percentage of the population as in 1870 — but if your wife has tried to hire a maid recently, she'll never believe it.

▲

UPSETTING an old belief, George Bernard Shaw says: "Do not do unto others as you would that they should do unto you — their tastes may not be the same."

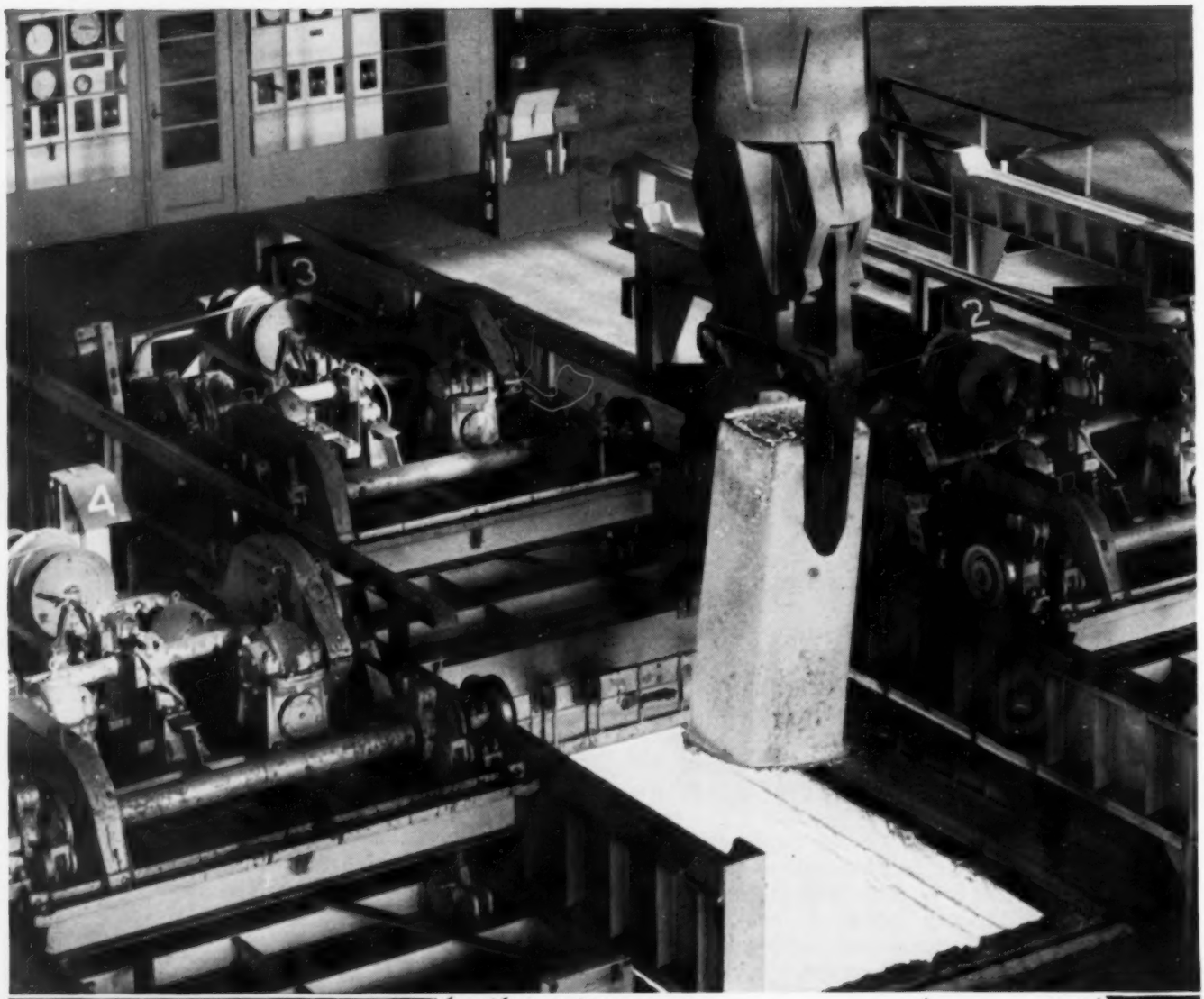
▲

THE 1948 AISE convention and exposition just concluded in Cleveland, Ohio, was record-breaking in many aspects. The exposition was the largest in Association history, and all previous attendance records were broken. Interest in the technical program was high. Comments from exhibitors and from those attending were enthusiastic. Mentioned particularly was the high quality of the attendance and the interest evidenced.

It is gratifying to feel that a good job has been done. The Association is proud of the constantly increasing recognition given its efforts, and it hopes that it can continue to improve and broaden its service to the industry. The members of the Association wish to express their thanks to all those who helped to make the various activities such a success. It is this kind of support that will enable the Association to carry on its work in the future.

▲

A MAN may be level headed, but it's also important to know how low the level is.



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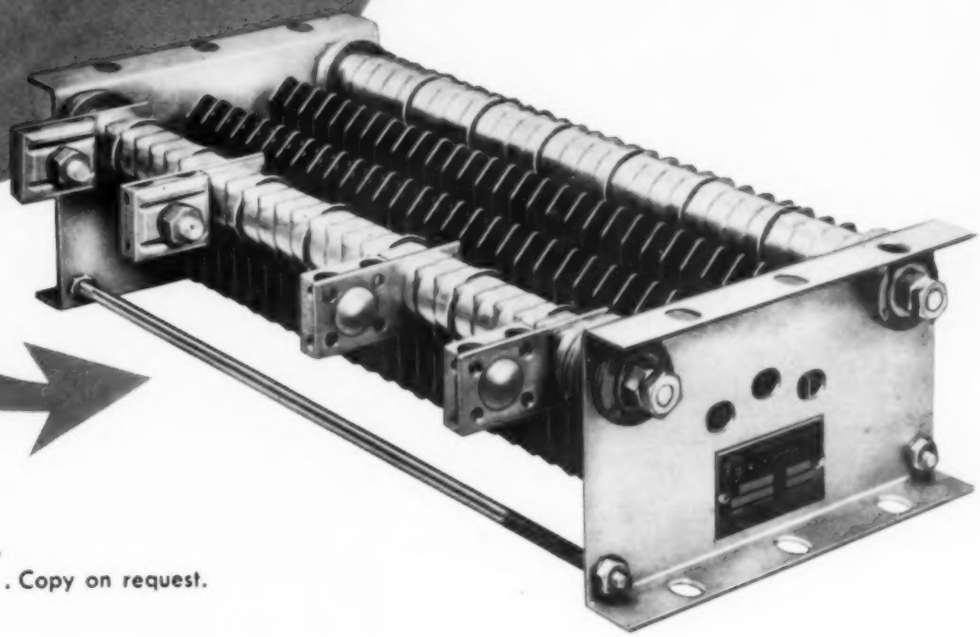

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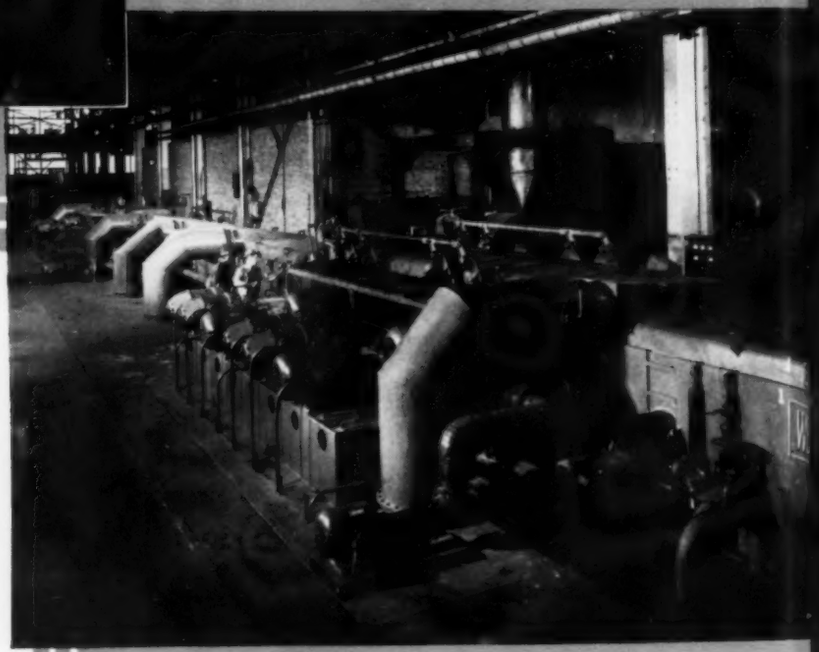

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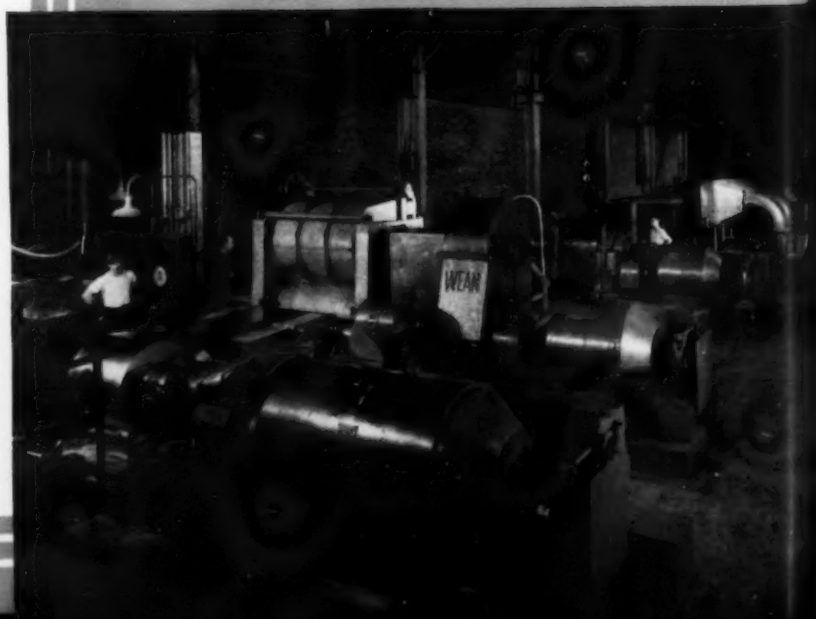

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Iron AND Steel ENGINEER

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Republic's 44-36-32 in. Mills AT CHICAGO

By R. F. LAVETTE
Superintendent, 44-36-32 in. Mills
Republic Steel Corporation
Chicago, Illinois

. . . . designed for war-time production, these mills nevertheless have a flexibility that permitted ready reconversion to peace-time products . . . .

▲ THE mills covered in this discussion were built and went into production in 1943 and 1944. They are part of a completely integrated steel plant constructed during the recent world war for the production of electric furnace alloy steel used in the manufacture of aircraft, guns, tanks, and a multitude of other items required by the armed services for the prosecution of the war. ("Republic Builds for D.P.C."—AISE Yearly Proceedings, 1944). The mill layout, the size and type of mills and all related equipment were dictated by the aforementioned requirements. The buildings housing the mills and the various processing departments comprise eight bays, varying from 1,250 to 1,500 ft in length x 100 ft wide, except the mill bay which is 90 ft wide. The total area covered is some 22½ acres, all under one roof, exclusive of the soaking pit building.

The soaking pits consist of twenty-four holes of one-way-fired recuperative pits, each hole being 25 ft long x 8½ ft wide x 15½ ft deep, with full automatic control of temperature fuel-air ratio, pit pressure, etc. These pits are unusually large and deep and were designed to handle a full electric furnace heat of 75 to 80 tons per pit, so that once started, the heating cycle would not be interrupted, as would be the case if parts of two heats were charged into the same pit at different intervals.

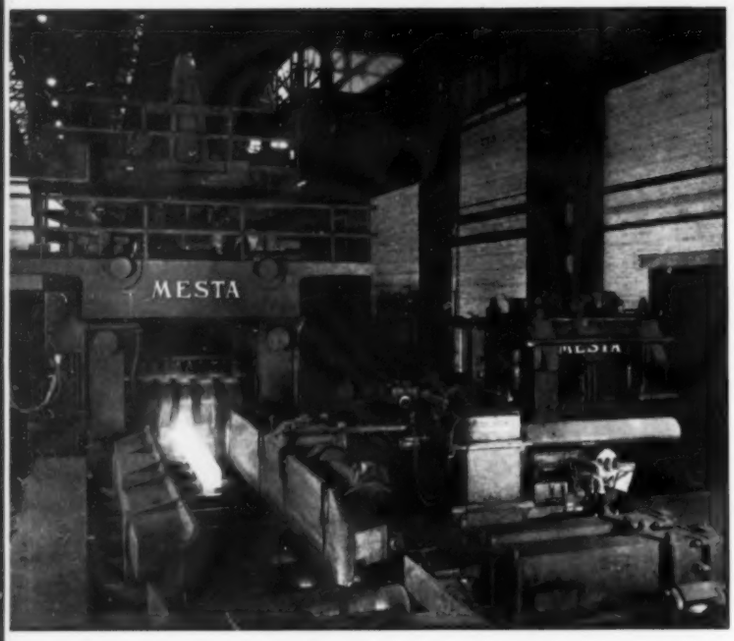
It was known at the time planning was begun that one of the items which would be required in quantity, was an ingot large enough to be used in the production of barrels for 155mm guns and 8 in. howitzers. The ordnance department, working in conjunction with our metallurgists, specified a chrome-nickel-molybdenum-vanadium analysis, and an ingot 34 in. x 34 in. x 167 in. long, weighing 34,000 lb. It was the unusual length of the ingot which made the 15½ ft depth of pit necessary. These gun barrels had formerly been produced by press forging. However, when designing the plant, it was felt that their production could be speeded up and certain economies effected if part of the reduction could be accomplished by rolling in the blooming mill. It was decided that the 34 x 34 in. ingot was to be rolled to a 24 x 24 in. bloom, after which press forging would be employed to complete the reduction of the rough gun forging.

These gun barrel heats consisted of four of the 34,000 lb ingots, and one 25 x 25 in., 9,500 lb ingot which was used for making preliminary physical tests for determination of acceptance of the heat.

In order to facilitate the handling of these blooms after rolling, one of the table girders of the runout table was built with recesses or notches between the rollers to permit the use of a specially constructed lifting cradle for lifting the bloom from the table to a transfer car, from which point they were moved to a battery of fully

Presented before AISE Annual Spring Conference, Philadelphia, Pennsylvania, May 26, 1947.

The rolls for the 44 in. reversing blooming mill are 96 in. long, and run in composition bearings.



A two-high 36 in. reversing stand does the roughing for the secondary mills.

controlled car-type annealing furnaces, where they were cooled slowly to prevent flaking or rupturing.

Since these blooms were too large to shear, certain preliminary tests were cut from the bloom by specially designed oxy-acetylene cutoff machines before being charged into the furnaces. After cooling, blooms were cut to length and etch tests cut from each end on a battery of 80 in. circular cold saws.

Handling an ingot of the size and weight mentioned indicated that a 44 in. mill would be required.

The 44 in. mill uses an alloy steel roll 44 x 100 in., has a hydraulic top roll balance, and is driven at 40 to 100 rpm by a 7,000 hp motor. Mill tables and other auxiliary equipment have roller bearings throughout and are equipped with the latest and most modern control. The 1000 ton bloom shear is electrically driven, and has start and stop control which eliminates the usual clutch. The shear has capacity for cutting 15 x 15 in. blooms. Crops are disposed of by cutting into a skip buggy operating on an inclined track and dumping into specially constructed standard gage cars developed for this type of service.

Cutting and handling of test pieces in connection with the production of alloy and other quality steels is usually an item of considerable importance. In this mill they are handled by means of a motor operated retractable chute mounted on rollers running on inclined ways through an opening in the side of the shear frame and actuated by rack and pinion. When securing a test, the shear depressing table is retracted and the chute moved through the opening in the shear frame until it is directly under the piece to be cut. The test piece falls into the chute and slides down to a flight conveyor which delivers the test to the test room opposite the shear. As soon as the test has dropped from the shear, the chute is withdrawn, the tilting table is run back and shearing is resumed, resulting in a minimum of time required to secure the tests.

Located between the 44 in. mill and ahead of the bloom shear is a machine for hot scarfing blooms as they are delivered from the blooming mill to the shear. This machine simultaneously scarfs all four sides of blooms ranging in size from 6 x 6 in. to 14 x 16 in. Depth of cut and amount of surface removal can be readily changed to suit any normal requirements, and at speeds of 125 fpm or more if necessary to keep ahead of the mill. Scarfing scale resulting from the operation is flushed into a pit with water sprays, from which point it is removed by clam-shell bucket.

Since the close of the war, the large ingot previously mentioned has been used in the production of numerous large alloy blooms such as die blocks, special forging blooms, etc. For the smaller sizes and for rerolling blooms for the 36 in. and 32 in. mills, the major part of the production is now rolled from a hot-topped ingot 25 in. square, weighing 12,000 lb, and open type steels from a 23 x 25 in. ingot, weighing 11,500 lb. Predominating blooms sizes for subsequent rerolling into billets, bars, etc., are 7 x 7 in., 8 x 8 in., 9 x 9 in., 10½ x 10½ in., 12 x 12 in., and 13 x 15 in., depending on the finished size required.

The 44-36-32 in. mills are laid out all in line in one bay which makes possible three different methods of processing:

1. Breakdown on 44 in. mill and send over transfer to either one of three bays for furnace, air or pit cooling; conditioning by scarfing or chipping, and recharging into reheat furnaces for finishing on 36 in. or 32 in. mills.
2. Breakdown on 44 in. mill and charge without cooling into reheat furnaces for wash heating and rerolling.
3. Breakdown on 44 in. mill and send direct to 36 in. and 32 in. mill and finish without reheating.

This layout also makes it possible to operate each mill as a separate unit or in combination.

Located between the 44 in. mill bloom across transfer and the 36 in. mill are two triple-fired reheating furnaces which discharge on to the same table which delivers direct from the 44 in. mill to the 36 in. mill. These furnaces are 23 ft wide x 78 ft-6 in. long, inside dimensions, and have a capacity of 75 net tons per furnace hour. They are equipped with recuperators and with complete automatic control.

When charging the reheating furnaces, blooms are placed on a reciprocating dog type charging skid, somewhat higher than the roller line behind the furnaces and located between the pushers. Dogs, moving the blooms forward, drop them on the roller line, from which point they are spotted in line with the furnace pushers.

The 36 in. mill is a two-high stand with removable cap and counter-weighted top roll, driven at 50 to 120 rpm by a 5,000 hp motor. Rolls are alloy steel 36 x 82 in. and are laid out to use either 5 or 7 passes in breaking down for the 32 in. mill. However, a number of variations from this method are possible when working in conjunction with the 44 in. mill, the customary procedure being to co-ordinate the work of both mills to obtain the best production rates. Manipulators and sideguards on both sides of the 36 in. mill make it possible to turn the bloom after each pass. Delivery tables and cross transfers are so arranged that by removing the 32 in. finishing stand, squares from 5 to 9 in. and some narrow slabs may be finished on the 36 in. mill and

sent to the saws while the 32 in. mill is undergoing a complete mill change, thereby permitting production to go on without interruption.

Tables between the 36 in. and 32 in. mills are 173 ft long, making it possible to roll a 4 x 4 in. or larger from a single bloom cut from a 12,000 lb hot-topped ingot.

The 32 in. mill consists of three two-high reversing stands. Intermediate rolls are alloy steel 32 x 72 in.; leader rolls 32 x 68 in. and finishing rolls 32 x 48 in. are grain iron. Intermediate and leader stands are coupled together and driven at 80 to 160 rpm by a 5,000 hp motor. The finishing stand is driven separately at 70 to 140 rpm by a 2,500 hp motor. Intermediate and finishing stands are equipped with universal couplings on the drive ends and have mechanical pullbacks for quick changing; all stands are held to the shoes by hydraulic clamps. Top rolls are balanced hydraulically, and have electrically driven screwdowns. All stands are equipped with composition roll neck bearings, this being standard throughout all three mills.

Because of the weights involved in most of the sizes produced on this mill it was necessary to provide mechanical manipulation at all stands. Blooming mill type manipulators were installed on both sides of the intermediate stand and on the entry side of the leader and finisher for turning large squares. Rounds from 3 in. up to and including 4¾ in., and squares from 2¾ in. to 5 in. are turned up into the leader and finisher by specially designed air-operated turning devices, thus eliminating any manual turning. All operations involving main drives, tables, manipulators, dragovers and turning devices are controlled from three elevated pulpits, one in front of each stand, with one operator in each.

The standard method of rolling in the 32 in. mill employs three passes in the intermediate stand, turning 90 degrees between each pass, one pass in the leader, and one in the finisher. The last pass in the intermediate is a former pass However, on rounds from 7¼ in. to 10 in. one pass in each stand is used. Double radius ovals are used in producing rounds up to 4¾ in., sizes larger than this being made from an octagon oval. Squares up to and including 5 in. are rolled by the diamond and square method, and larger sizes are rolled in box passes.

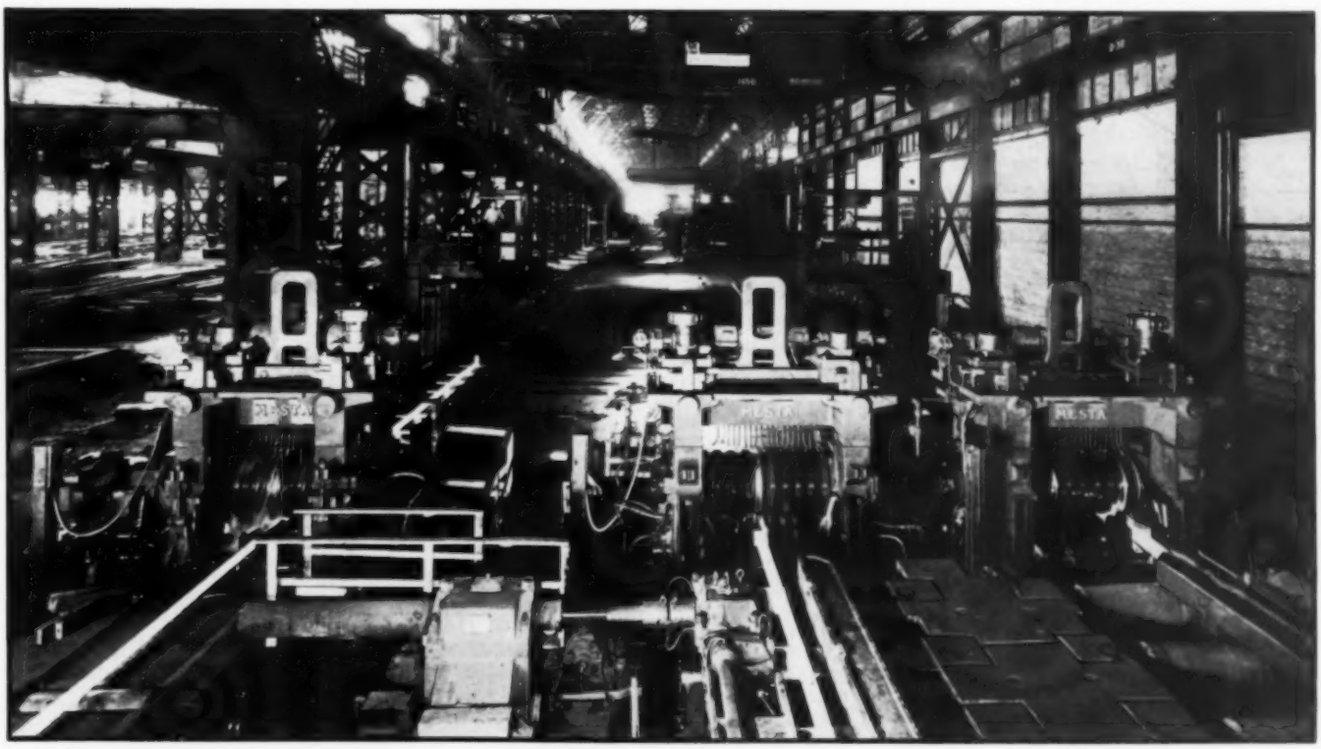
To provide for greater flexibility and reduce the number of mill changes, the rolls in the intermediate and leader stands are turned to permit the rolling of rounds from 3 in. to 4⅝ in. and squares from 2¾ in. to 4¼ in. on combination sets, requiring a change of finishing stand only.

Roller entry guides are used on rounds up to 8 in. All other guides are bolted to rest bars, no hanging guide equipment being used. Adjustable idler feed rollers, supported in roller bearings, are used on mill housings to prevent contact between the bar and the stripper guides, thus eliminating scratching. Spare housings have been provided for each stand and all changes are made at the build-up station in advance of rolling.

The delivery table from the finishing stand can accommodate a finished bar 182 ft long, and is arranged to deliver by transfer to two 60 in. sliding frame hot saws set opposite each other, each with its own approach and runout table and delivering to a common roller line to the cooling beds, after being sawed to length and identified.

Practically all product rolled on this mill is stamped with ingot number, heat number and cut number on each bar. This is accomplished by placing a stamp holder containing all the necessary stamps against the stop at the end of the saw runout table, and permitting

Three 32 in. stands placed side by side compose the finishing mill. The first two stands are operated together as a reversing unit from a single 5000 hp motor.



the hot bar to strike against the holder, the impact making a clear and legible impression. From this point the finished material moves to the cooling beds and cradles. A reciprocating dog type transfer bed has been provided for the fast handling of critical alloy items to slow cooling pits while still hot, to prevent flaking or rupturing.

Two cooling beds, 39 ft wide x 80 ft long, are arranged to handle material either singly or in double rows, depending on the length. After cooling, the product is moved off the bed on to a roller line which delivers to the cradles. Rack-type pushers push into the cradles, which are equipped with motor operated piling devices for compact bundling of squares. Scales are built into the cradles to permit the weighing of the finished product before removing to cooling pits, cars, or storage and processing areas.

Test pieces taken at the saws are handled by means of a test box or catcher mounted on a track and operated by air cylinders which moves the box under saw blades. After the test is cut, the box is withdrawn to a point where the test can be taken out, identified, and sent to the laboratory.

Ample space and facilities have been provided for final processing and shipping of the finished product. Squares and rounds up to 9 in. may be straightened either on gag or round straighteners, and a complete special process department containing a roller hearth heat treating furnace and 10 car-type furnaces, all fully controlled are available for heat treating, annealing, normalizing, etc.

In laying out and designing these mills, every effort was made to use mechanical equipment to take care of handling problems. For instance, coke breeze for soaking pit bottoms is dumped into a track hopper from hopper bottom cars, elevated to overhead bins by conveyor, and feeds by gravity to boxes for distribution to the pits by soaking pit cranes. Soaking pit covers have dual controls. Under normal operating conditions, the soaking pit craneman opens and closes covers from the crane cab. Floor controls are used by the heater when making periodical observations during heating. Mill scale in the 44 in. mill is handled by a combination of mechanical conveyor and flushing system to a sump pit, from which it is loaded into cars by mill crane and clam-shell bucket. Mill scale from the 36 in. and 32 in. mills is flushed out with water to pits and handled in a similar manner.

An intercommunicating speaker system installed throughout the soaking pit and mill buildings expedites the transmission of verbal orders and messages to the various key points, thereby eliminating numerous small mill delays.

At the time of this writing, a continuous billet mill is being installed in line with the existing three mills, and will be used to furnish $2\frac{3}{16}$ in. and 3 in. rerolling billets to 10 in. bar and rod mills. This is an eight-stand 21 in. mill driven by a 6,000 hp motor, and will roll the $2\frac{3}{16}$ in. billet from a 6 x 6 in. bloom. Product is cut by a steam driven flying shear to 28-30 ft lengths to finish 450-460 lb coils on the rod mill. Rolling will be direct from soaking pits through 44 in. and 36 in. mills using a 25 in. square hot-topped ingot weighing 12,000 lb and an open top ingot 23 x 25 in. weighing 11,500 lb.

DISCUSSION

PRESENTED BY

P. T. REYNOLDS, Roll Designer, Republic Steel Corporation, Massillon, Ohio

R. F. LAVETTE, Superintendent, 44-36-32 in. Mills, Republic Steel Corporation, Chicago, Illinois

CHARLES P. HAMMOND, Superintendent, Rolling Mills, Atlas Steels, Limited, Welland, Ontario, Canada

A. G. ERICSON, Chief Engineer, Homestead Steel Works, Carnegie-Illinois Steel Corporation, Munhall, Pennsylvania

S. C. READ, Manager of Maintenance, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

L. M. IMMEL, Superintendent, Blooming Mills, Republic Steel Corporation, Canton, Ohio

W. B. HAUS, Superintendent, Blooming Mill, Alan Wood Steel Company, Conshohocken, Pennsylvania

WADE F. HOFFMAN, Superintendent Roll Shops, Jones and Laughlin Steel Corporation, Aliquippa, Pennsylvania

W. J. BURNS, Roll Designer, The Midvale Company, Nicetown, Philadelphia, Pennsylvania

J. M. MORRIS, Superintendent of Maintenance, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

P. Reynolds: I am especially interested in the testing. One of our great headaches is the identification of tests to match the rolled bar sampling. The mill has been able to identify very satisfactorily all of the steel by ingot number, piece number, top and bottom, etc., but it has been a problem to have the test match the rolled bar. I wonder if you could give us a word of explanation on that.

R. F. Lavette: In our particular case, the necessary information is given to the test man in the test room on a sheet of paper. In other words, he gets the same information that is sent to the roller, shearman and recorder, and the instructions for getting the various tests are on that sheet.

C. P. Hammond: One thing I am interested in is the size of the soaking pits, as they were built for very long ingots. Has there been any noticeable difference in fuel requirements, with the use of short ingots in proportion to the number of tons that could be heated with the use of the long ingot? You mentioned you had discontinued the use of the double radius oval. Would you explain the reason for getting away from the use of the double radious oval?

R. F. Lavette: We feel that we get about the same fuel efficiency with the deep pit as with a shallow pit. About the only difference would be the difference in radiation losses due to greater wall areas.

As to why we do not use the double radius ovals on the larger sizes, this is due to the fact that the larger rounds are rolled from exceedingly heavy blooms, and we have a device to turn and hold up the double radius

ovals up to a certain size, but did not think it ought to be made larger than that, because it might have gotten too clumsy and cumbersome. The octagon oval stands up by itself, of course, and does not require any device to hold it up.

A. G. Ericson: I have one question: In these enormously large pits, do you have uniform heating from top to bottom of the ingot? Or have you found any great difference?

R. F. Lavette: We get uniform heating from top to bottom. Due to the kind of operation we have had up to now, we do not have a really good picture of what the full rate would be, because we have been operating generally on a one-turn basis.

A. G. Ericson: What type of recuperator do you use?

R. F. Lavette: The recuperator consists of horizontal tubes of silicon carbide.

S. C. Read: Do you get some fumes in the mill building from the hot scarfer?

R. F. Lavette: No, the fumes from the hot scarfer are well disposed of. We have a duct leading off from the hot scarfer and there is absolutely no evidence of fumes in the building at all. It is very clean.

L. M. Immel: In breaking down ingots to the $2\frac{3}{16}$ in. billet you spoke about, directly from the ingot, to what extent does the hot scarfer enter into the picture?

R. F. Lavette: That depends entirely on the type of steel. We would not consider using the scarfer at all on some of the ordinary grades, but for cold-heading or for steels requiring a very good surface quality, we would expect to condition those in the scarfer.

L. M. Immel: Are there any of the types that are more susceptible to ingot cracks—that is, cracks that seem to be in the ingot when it arrives in the soaking pit? Do you remove those to the extent that it may not require cleaning when it gets into the small billet?

R. F. Lavette: If there is any considerable depth to the cracks, it is money thrown away to try to hot-scarf them.

W. B. Haus: I would like to ask first how you load your slow cooling pits from your skids or tables? I also would like to know the difference in the temperature between your roof thermocouples and the actual temperature of the steel drawn from your soaking pits.

R. F. Lavette: Answering the first question, steel is dumped from the bloom transfer leaving the blooming mill into a cradle and picked up with chains, and deposited in the slow cooling pits with chains.

Answering the second question, the temperatures are measured by a radiation pyrometer located in the front wall of the pit and we feel that the temperature throughout the pit is fairly uniform when the steel is heated and ready to roll.

S. C. Read: The steel travels quite a distance from the time it leaves the soaking pits to the time it is a finished product. What temperature is the steel at delivery from the finished last pass?

R. F. Lavette: It depends entirely on the grade of steels. Some are heated to higher temperatures than others. We do not feel that we lose any more than the normal amount of temperature, because we break down pretty fast. We take a large bloom from the 44 in. mill and finish production on the other mill. At the rate we roll, it does not lose temperature too fast.

Wade Hoffman: I would like to know what kind of roll-neck bearings are used on the 44 in. mill.

R. F. Lavette: All units are equipped with fabric roll neck bearings.

W. J. Burns: How are these fabric bearings lubricated, and what are the makes?

R. F. Lavette: These bearings are all water-lubricated, and we have used four different makes, apparently with equal success with all four of them. We find very little difference in them, as far as service goes.

J. M. Morris: Are the rolls on your blooming mill ragged, knurled, or plain?

R. F. Lavette: On what we call the standard rolls, used for breaking down the normal product for rerolling, we have ragging on the bullhead. We finish quite a number of sizes going directly to the trade. They are large blooms, and of course, the trade prefers a smooth finish. We have a special set of rolls we use for making these large sizes. They are plain, without ragging.

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Columbia Steel's New Sheet and Tin Mill

. . . . important to the development of the west will be the steel products to be produced by the new sheet and tin mill of the Columbia Steel Company . . . . these facilities are only a portion of a $25,000,000 expansion and modernization program under way by this United States Steel subsidiary at Pittsburg, California . . . .

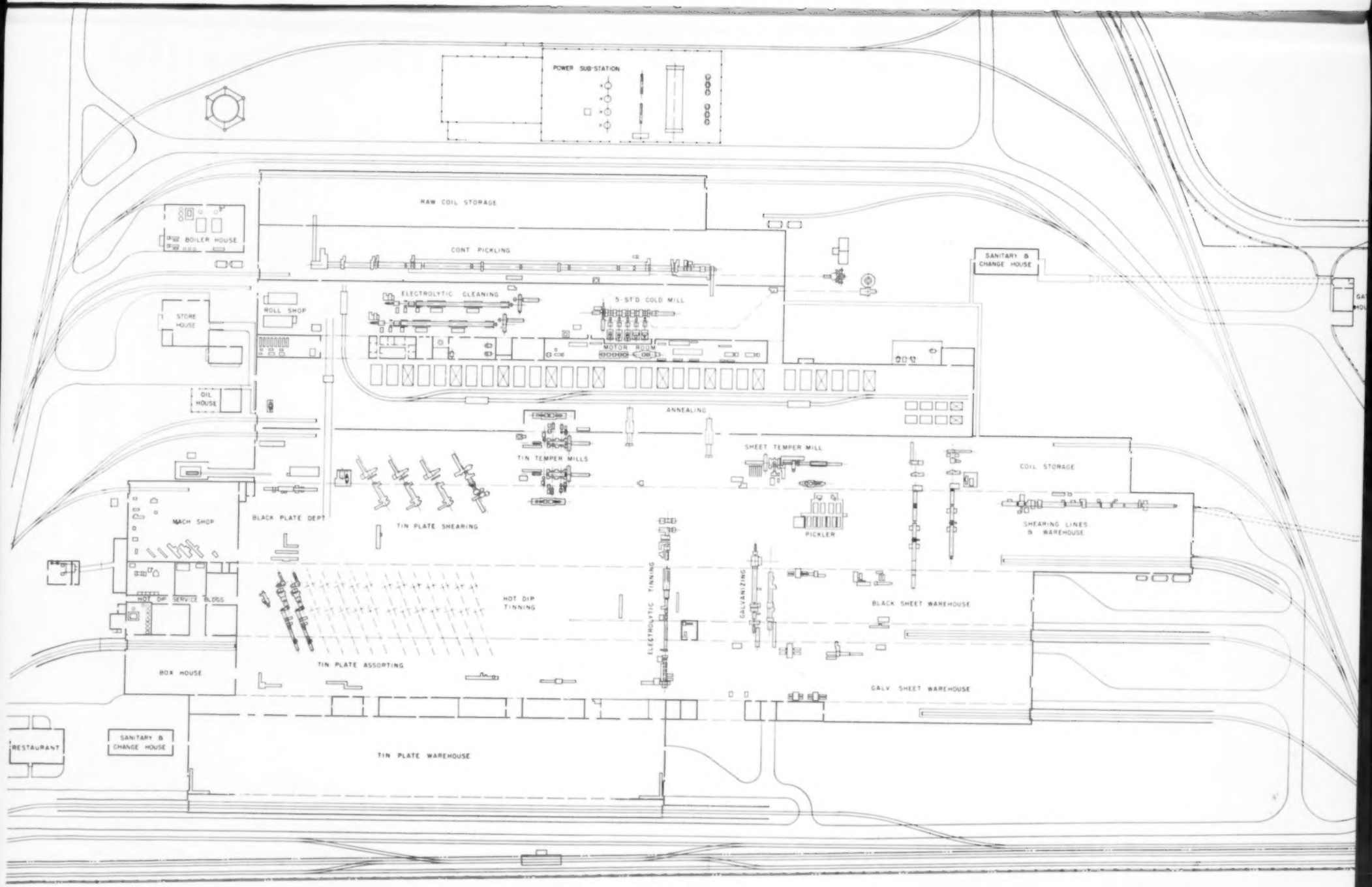
By PAUL F. KOHLHAAS
Vice President in Charge of Engineering
Columbia Steel Company
Oakland, California

▲ CONSTRUCTION of a new cold reduction mill and complete finishing facilities at its Pittsburg, California, plant by Columbia Steel Company has added cold-reduced sheet steel, as well as cold-reduced tin plate and cold-reduced galvanized sheets to the long list of products manufactured by this United States Steel Corporation subsidiary to meet the diverse needs of the west. Addition of the new mill to the plant will not reduce output of any of its regular products, but will actually make available more steel from its open hearth furnaces for these products. This is because steel for cold reduction will be obtained in the form of hot-rolled coils from Geneva Steel Company, or other subsidiaries of United States Steel. Thus, steel formerly applied to the manufacture of sheets and tin plate will now be available for increased production of items in the regular list of products, none of which will be discontinued. The list of products will embrace merchant bar and bar shapes, reinforcing bar, cold-reduced sheets, electrolytic and hot dip cold-reduced tin plate, cold-reduced galvanized flat sheets, galvanized culvert stock, galvanized sheets for roofing and siding, bright wire, annealed wire, galvanized wire, spring wire, welding wire, barbed wire, bale ties, fishtrap netting, fence, nails, wire rope, strand, and steel castings.

Forming only part of a long-range modernization and expansion program, the new production units added to the Columbia plant include a five-stand, four-high cold-reduction mill, a continuous pickling unit, two electrolytic cleaning lines, ten cover-type coil annealing furnaces, two two-stand tandem four-high tin temper mills, three tin plate shearing lines, one tin plate side trimming and recoil line, one single-stand four-high sheet temper mill, a sheet shearing line for cold-reduced steel, two auxiliary sheet shearing lines, a sheet galvanizing line, fourteen hot dip tinning lines and auxiliaries, an electrolytic tinning line, and sixteen mechanical assorting, reckoning and piling lines for tin plate.

The usual auxiliary and service buildings such as mill and departmental offices, storehouse, wash and locker rooms, restaurants, hospital and laboratory have been provided. The laboratory is worthy of note in that it has been provided with all of the latest instruments and

Aerial view of the new sheet and tin mill of the Columbia Steel Company, in Pittsburg, California. In the left background, adjacent to the overhead water storage tank, is the new clarification and filtration plant that purifies water for use in this new United States Steel Corporation subsidiary plant. Behind the water plant is the wire rope mill, added to the plant facilities during 1942. Facilities behind the sheet and tin mill extending into the right background include the open hearth departments, wire mill, rolling mill, continuous rod mill, foundries, and other units. The water channel that gives eventual access to the open sea for shipping and receipt of steel products is visible in the right background, and is known locally as New York Slough.



Layout of new cold reduction mill and finishing facilities recently completed by the Columbia Steel Company at its Pittsburg, California plant.

equipment necessary to control processes and the final products.

FLOW OF MATERIAL DURING PROCESSING

Hot-rolled coils received at the plant are accommodated in a large storage bay, from which material is drawn as required to meet rolling schedules. Coils intended for processing on the cold-reduction mill are first run through the continuous pickling unit, where they are thoroughly cleaned. The long lengths of cleaned steel are recoiled at the end of the pickling line, and taken to the cold-reduction mill, where they are reduced approximately to the desired final thickness and recoiled on leaving the mill. Oil that accumulates on the material during rolling is removed in an electrolytic cleaning line. The steel is uncoiled continuously at the entrance end of the cleaning line, and recoiled as it leaves the line.

Material intended for processing into sheets is then loaded in coil form into the sheet coil annealing furnaces. After annealing, it is run through the sheet temper mill to produce the exact final thickness, proper surface and physical properties. The recoiled material leaving the temper mill is then run through the cold-reduced sheet shear line, where it is cut into accurately controlled sizes, according to order. When necessary, the sheets may be run through a resquaring and scrubbing line.

Sheets intended to be galvanized are pickled after shearing and then run through the galvanizing line, after which they are inspected prior to stocking or shipment.

Cold-reduced steel to be processed into tin plate, after cleaning in the electrolytic cleaning line, is loaded in the tin coil annealing furnaces and, after annealing, run through the tin temper mills, where it is reduced to the desired final thickness. After temper rolling, the flow of material is split, according to whether the steel is to be tinned electrolytically or by the hot-dip process. If to be tinned electrolytically, it is passed through the tin plate side trimming and recoiling line, cleaned, electrolytically plated with tin, and sheared into the ordered sizes, inspected and assorted as it comes off the tinning line.

Hot-dip tin plate is produced by cutting the cold-reduced, annealed and tempered steel into sheets of the proper size, in three continuous shear lines followed by pickling, tinning, and inspection and assorting of the plate as it passes out of the tinning lines.

In both types of tin plate production, the finished plate is ready for packaging and stocking or shipment after assorting.

Overall view of the five-stand, tandem, four-high, cold-reduction mill. Finishing speed of this huge unit is about 3900 fpm. Previously pickled coils of flat-rolled steel pass continuously through the five rolling mills, and emerge at the opposite end reduced to the desired thickness for further processing. Main motors driving this mill total 15,500 hp.

PRODUCTION OF COLD-REDUCED SHEETS

One important product is the sheet steel in cold-reduced, annealed and tempered grades. Starting material for this major product is pickled, hot-rolled steel in coil form, processed in a continuous pickling line.

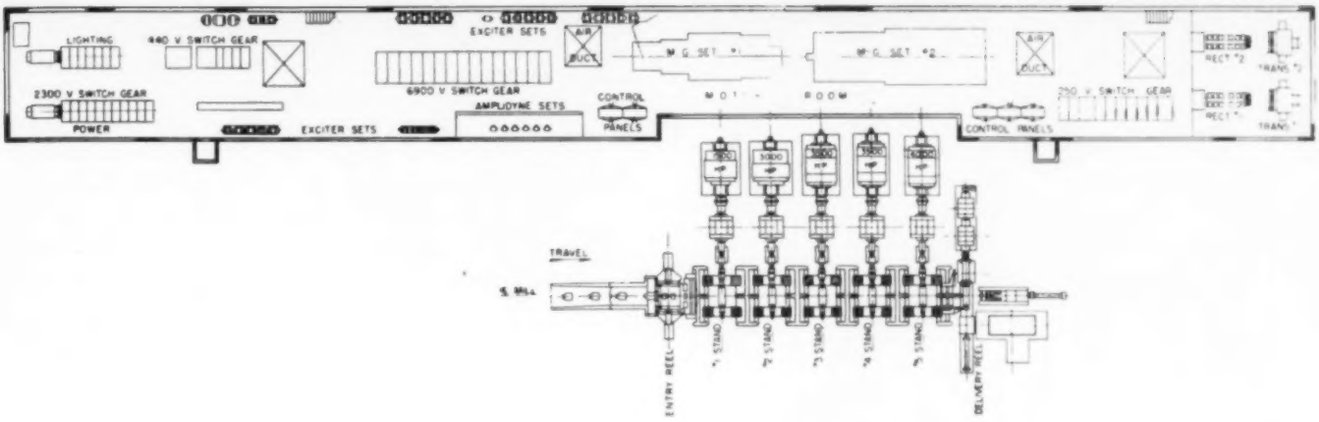
Continuous pickling unit—The continuous pickling unit can process mild steel coils of 30 in. inside diameter, 58 in. outside diameter, 54 in. maximum width, and thickness from 0.1875 in. to 0.060 in. Coils fed into the continuous pickling unit first pass through a processing uncoiler. An upcut shear crops the ends of the coils. The trailing end of a coil is joined to the leading end of the succeeding coil by an upstroke stitcher equipped with heavy pitch rolls and air-operated entry side guides. The stitcher is followed in the line by a looper-guide pit, in which slack can accumulate to provide a loop that allows the line to operate continuously while the end of the coil is momentarily halted for the stitching operation. This pit also serves the important function of aiding the guiding of the material into the line. The looper-guide pit side guides have structural steel side frames with steel plate surfaces, and can be adjusted independently.

The pickling operation takes place in a series of five rubber-lined, brick-sheathed tanks. The first four contain the acid pickling solution. Inside the brickwork, each tank is 68 in. wide and 70 ft long. The fifth tank is a combination hot and cold water rinse tank, 19 ft, 5 in. long and 92 in. wide. The tanks have rubber-lined covers. Acid supply is controlled automatically. Indicating and recording instruments control the temperature of each tank, and regulate additions of water, acid, and steam. Support and hold-down rolls control the passage of steel through the successive tanks.

A fume exhaust system with a fan that can handle 20,000 cfm maintains good working conditions in the area. The system incorporates a moisture eliminator that removes condensed vapors from the exhaust.

Average speed of material through the pickling line is about 350 fpm.

Following the rinse station is a dryer and a cut-out shear to separate the successive lengths as the stitched portions emerge from the line. The dried steel passes through a continuous side trimmer to reduce it to accurate width, after which it is recoiled for delivery to the cold-reduction mill. Oil is applied to the metal during recoiling, thus protecting it from rust before rolling.



General plan of 5-stand cold reduction mill.

Five-stand cold-reduction mill—The five-stand tandem four-high cold-reduction mill, which is designed to operate at a nominal finishing speed of 3900 fpm, consists of five identical stands having cast steel housings with a post area of 870 sq in. and 1½ in. thick steel window liners. The work rolls are 21 in. in diameter with a 56-in. face, equipped with four-row 13.506-in. inside diameter roller bearings. Back-up rolls are 53 in. in diameter with a 55-in. face, and are equipped with pressure lubricated radial bearings and roller thrust bearings. The screwdowns are equipped with both drum-type and electrical indicators. Main mill motors operate on 600-volt direct current. Their maximum speed is 745 rpm. The first stand is driven by a 1500-hp motor. A 3000-hp motor drives the second stand. Stands No. 3 and 4 each are driven by a 3500-hp double-armature unit, while a 4000-hp double-armature motor drives the fifth stand. Direct current for these drives is provided by two motor-generator sets, one of which is driven by a 6600-hp motor and the other by a 13,300-hp motor, both 6900-volt a-c.

At the exit side of the cold reduction mill are a reel and stripper. The reel has a 20-in. diameter collapsible steel drum of the three-section type with a gripper. Also at the exit side is a belt wrapper employing two 12-in. wide belts, with a double-acting air cylinder that provides for a traverse stroke of 6 to 8 ft.

Two circulating oil systems are provided for lubrication of the back-up roll bearings, with two separate systems for recirculating lubricating oil for the screwdowns, gear drives, pinion stands and speed increaser. There are also two motor-operated, centralized pressure grease systems for the mill roller bearings, spindle carrier bearings, chock slides, pressure block screws, splines, etc. Two manually operated systems supply grease under pressure to the uncoiler and reel.

A roll coolant system which utilizes soluble oil in water for the coolant has been provided. The palm oil used in the rolling operation is handled by a separate system. Fog produced during rolling is eliminated through an exhaust hood connected to a fan that discharges through an 85-ft stack. A vapor trap eliminates condensate from the exhaust stream. A palm oil recovery system is also provided.

When rolling 60-in. outside diameter coils 16-38 in. wide with a maximum thickness of 0.125-in. to a minimum tin plate gage of 0.006-in., the capacity of the mill is estimated to be about 450 net tons per eight-hour turn.

Electrolytic cleaning lines—One of the two electrolytic cleaning lines was designed to handle coils in tin plate widths up to 38 in.; the other, coils in sheet widths up to 54 in. The two lines are generally the same in design, except for such differences as are made necessary by the difference in width and gage of the two classes of product. A payoff reel uncoils the cold-reduced steel as it enters the line. Successive lengths passing through the cleaning line are seam welded end to end to provide a continuous feed to the line. Two air-operated shears cut off the crop ends of the coils prior to the welding operation. A single air-operated shear is at the exit end of the cleaning line.

The cleaning tank is approximately 135 ft long. It is furnished with sectional covers that are pneumatically operated. In series, the installation consists of a cleaning section, a scrubbing section, a second cleaning section, a second scrubbing section, and a final rinse section. Travel through the sections is controlled by sink rolls, brush scrubbing and brush back-up rolls, and rubber rolls, distributed along the line. Four sets of grids with bus bar extensions over the edge of the tank supply the cleaning current. A 25 ft dryer table follows the cleaning line. It is equipped with two blowers for heated air. As the product leaves the cleaning line, it is wound again into coils.

The 54-in. electrolytic cleaning line operates at a maximum speed of 2000 fpm, with steel sheets 0.065 in. thick or lighter in coils of 20 in. inside diameter, up to 66 in. outside diameter, up to 54 in. in width, and up to 30,000 lb maximum weight.

Annealing furnaces—Ten rectangular gas-fired cover type annealing furnaces have been installed in the new sheet and tin mill for the heat treatment of cold reduced coils of steel. Thirty bases have been installed for these furnaces, each base accommodating eight stacks of coils to a piling height of 150 in. and a diameter of 56 in. The furnaces were designed for operation with metal temperatures up to 1350 F.

Each furnace is 13 ft, 2 in. wide and 28 ft long (inside dimensions) and 13 ft, 4¾ in. in interior height from parting line to spring line of the roof. The furnace shells are constructed of steel plate reinforced with structural

View taken from the crane platform in the cold-mill motor room. The motor-generator sets for the main mill-drive motors are in the left rear of the room, at floor level.

steel members and are equipped with structural lifting rings. They are lined throughout with insulating refractory.

The thirty bases are of structural steel construction, and each has a sand seal extending around all four sides and eight circular steel load plates mounted on sectional castings. Bases have 2½ in. of insulating block for their bottom lining course over which has been laid insulating concrete and refractory concrete. Eight recirculating fans driven by 1½ hp electric motors are provided in each base.

Heat is supplied to each furnace through 40 recirculating radiant tube-type combustion units. The tubes are constructed of chromium-nickel heat-resistant alloy. Each furnace has an individual fuel-air proportioning carburetor, test burner and lighting torches.

There are two control panels with the controls for five furnaces on each. The panels incorporate ten two-point recording controllers, ten eight-point recorders, ten manual droop corrector units and two automatic indicators. Each panel has a cord and plug for the automatic indicator, five control circuit plugs, five control thermocouple plugs, fifteen control circuit receptacles, fifteen control thermocouple receptacles, ninety recorder couple jacks, and five recorder cables with seven plugs each.

Stacks of coils are protected during the annealing operation by covers 62 in. in diameter and 165 in. high, constructed from 5/16 in. open hearth steel plate.

Combustion air fans are of turbo-compressor design and are driven by totally-enclosed fan-cooled electric motors with magnetic starting equipment.

To prevent oxidation of the steel surfaces during annealing, a separately-prepared controlled atmosphere is maintained in the furnace during operation. This atmosphere gas is supplied by three generators having individual capacities of 10,000 cu ft per hr. Each machine incorporates a refrigerating unit for cooling the prepared gas to reduce its dew point to approximately 40 F. The blower that supplies combustion air to each generator is driven by a 3 hp motor. Each refrigerator is driven by a 7 hp motor. A typical composition of atmosphere gas generated by these units is as follows:

	Per cent
CO_2	5.80
CO	9.80
CH_4	0.05
H_2	11.00
O_2	0.00
N_2	72.90

Additional gas equipment for annealing tin plate will be available later.

All of the foregoing furnaces are employed in annealing cold-reduced steel. Normally six of the furnaces are engaged in annealing coils of cold-reduced material intended for processing into tin plate. The other four are normally employed in annealing coils that ultimately will be made into steel sheets.

The use of controlled atmosphere to prevent oxidation of the coils during annealing makes it possible to take annealed coils directly to the temper mills for rolling without an intermediate cleaning operation.

As previously mentioned, the stacks of coils are protected by inner covers slipped over the stacks before the cover furnace is set in position on the base. In addition to providing an added measure of protection to the coils during annealing, these covers permit the furnace to be lifted from the base, leaving the stacks of hot coils under their covers to cool while the furnace is transferred to another loaded base so that annealing of a second lot can begin without delay. Due to the long cooling times involved in lowering the temperature of the coils from annealing to room temperature, this practice results in great economy of time, since the heating unit is not tied up during the cooling cycle but is engaged in heating another load of coils. Altogether 240 of the inner covers have been provided to enable the annealing department to operate continuously on normal output.

Sheet temper mill—A single-stand, four-high sheet temper mill has work rolls 21 in. in diameter with a 60 in. working face, mounted in four-row, 13.506 in. inside diameter roller bearings. The back-up rolls are 49 in. in diameter, with a 60 in. face, turning in radial sleeve oil-flooded bearings and equipped with roller-thrust bearings.

The mill is designed for a maximum speed of about 1000 fpm. Product ranges are from 20 in. minimum inside diameter to 60 in. maximum outside diameter coils, 24-50 in. wide. Sheet product may vary between 0.012 and 0.1875 in. in thickness up to 50 in. wide, and 42-240 in. long.

Cold-reduced sheet shearing line—Sheets are cut to ordered sizes from coiled stock on a 54 in. sheet shearing line, designed to operate at a maximum speed of 400 fpm, and to side trim and end shear cold-reduced, annealed and tempered mild steel from centerless coils 20 in. inside diameter and 66 in. maximum outside diameter. Coil widths may range 24-54 in., thicknesses 0.012-0.105 in. Maximum coil weight is limited to 30,000 lb. Sheets can be cut into lengths ranging 36-168 in. If resquaring is necessary, it can be performed on an auxiliary line which will be described later in this paper.

Coils are handled at the entry end of the sheet shearing line on a ramp built of steel sections and equipped with four pneumatically operated coil stops so as to accommodate four maximum size coils. The uncoiler is of the overhung, expanding mandrel type, with hydraulically operated coil carriage having both traverse and lift and a hydraulic coil centering guide. The entire uncoiler is mounted on a sub-base with machined ways, so that by means of a hydraulically actuated cylinder having a maximum stroke of 6 in., the machine may be moved laterally for centering with the shear line. To control the length of the loop of material allowed to accumulate between the uncoiler and the side trimmer that follows it in the line, a photoelectric loop control unit has been provided.

The 12 in. side trimmer is of adjustable housing type, with bronze guides adjustable for width and thickness. Knife arbors are mounted in each housing, and run on tapered roller bearings. Entry side guides are of the steel wear plate type, adjustable for width by handwheels with right hand and left hand screw units. A brass roller rotating in internal ball bearings precedes the side guide to convey material into the side trimmer. A photoelectric control for regulating the length of the loop between the side trimmer and the flying shear is in the line. A flying micrometer has been installed for continuously gaging product thickness before shearing.

The flying shear is of the guillotine type, and includes ten 3-$1\frac{5}{16}$ in. diameter flattening rolls, two pairs of pinch rolls, side guides and a deflector roll. Sheets are conveyed away from the shear on a stationary type belt conveyor approximately 22 ft long. This is followed by a short removable length of conveyor allowing for the future installation of a roller leveler, that precedes another 22-ft motor-driven stationary type inspection belt conveyor that carries the sheets to the classifying sheet piler. This piler is equipped with an electrically operated deflector gate for shunting rejected sheets onto a roller conveyor with pinch rolls that carries the sheets to the reject piler.

The reject piler consists of a double-row gravity conveyor, with two pneumatically operated adjustable side guides and a disappearing and adjustable end stop.

Prime sheets pass over the deflector gate onto a motor-driven belt conveyor approximately 22 ft in length.

A retractable oiling machine which can be replaced by a conveyor section is installed in the line. This machine is motor-driven, and provided with an oil draining board and sump. It is arranged to permit passage of rejected sheets underneath it to the runout conveyor section. A motor-driven pump is provided for circulating the oil between the sump and two distributing headers. The unit incorporates the use of four felt rolls, 6 in. in diameter, that apply oil to the sheets.

The prime piler consists of a double-row gravity conveyor with two pneumatically adjustable side guides, disappearing and adjustable end stop for the piler section, an air-actuated roller brake, a 15-ton recording scale, and a fixed end stop for the runout section. Length of the roller conveyor is about 40 ft. A prime sheet counter tallies the product as it is piled.

One-shot lubrication is employed on the side trimmer and flying shear.

The uncoiler incorporates a 20 hp motor for the main drive, a 25-hp motor on the hydraulic pump drive, and a one-hp motor for driving the lubricating pump. A 20-hp motor forms the main drive for the side trimmer, with a 5-hp motor driving the lateral adjustment. Main drive of the flying shear is a 75-hp motor, with a 3-hp motor as a lubricating pump drive. The three belt conveyors are each driven by a 10-hp motor. The oiling machine main drive is a $7\frac{1}{2}$-hp motor, while the oil pump drive on this unit is supplied by a one-hp motor. All of the main drive motors mentioned above operate on 230 volt direct current, as do the belt conveyor drives. All other motors referred to operate on 440 volt, 3-phase, 60-cycle alternating current. All of the alternating current motors are totally enclosed.

Auxiliary shearing line—A 54-in. sheet shearing line operates at a maximum speed of 300 fpm, and uncoils, side trims and end shears hot rolled steel from centerless coils. Coils have an internal diameter of 30 in. and

Metalclad switch gear (left) and mill control switchboard (right) for 6900-volt a-c, in the cold mill motor room. The 250-volt d-c switch gear in this room is at the far end of this room, beyond the motor-generator set seen extending past the metalclad switchgear at the left.

maximum outside diameter of 58 in. Maximum width of material, ranging 10-22 gage, that can be handled in the line is 56 in. Maximum coil weight is 14,000 lb. Sheet sizes that can be cut range 16-15 in. wide in lengths from 3 ft to 18 ft.

Coils are handled at the entry end of the line by a conveyor 25 ft long. This is a trough conveyor running at right angles to the center line of the line. The conveyor can handle coils of the maximum size and weight outlined above. It is equipped with air actuated brake sections for three coils, and has a disappearing end bumper. At the down end of the conveyor, an air actuated side tilter receives coils from the conveyor and tilts them onto the processing uncoiler carriage.

The processing uncoiler is of heavy design, using 6½-in. diameter leveling rolls, a 5-in. diameter processing roll, and 8-in. diameter pulling rolls. The uncoiler is complete with hydraulically actuated coil car with hydraulic traverse and lift for positioning the coil on the mandrel.

There is a looping table between the uncoiler and the side trimmer, which is a 12-in. diameter side trimmer of the adjustable housing type, having bronze guides adjustable for width and thickness. Knife arbors are mounted in each housing, and run on tapered roller bearings. Entry side guides are of the steel wearing plate type, adjustable manually by handwheels for width. A brass roller rotating in internal ball bearings precedes the side guide unit to convey the material into the side trimmer. Scrap chutes guide scrap away from the unit. Another looping table follows the side trimmer and precedes the flying shear.

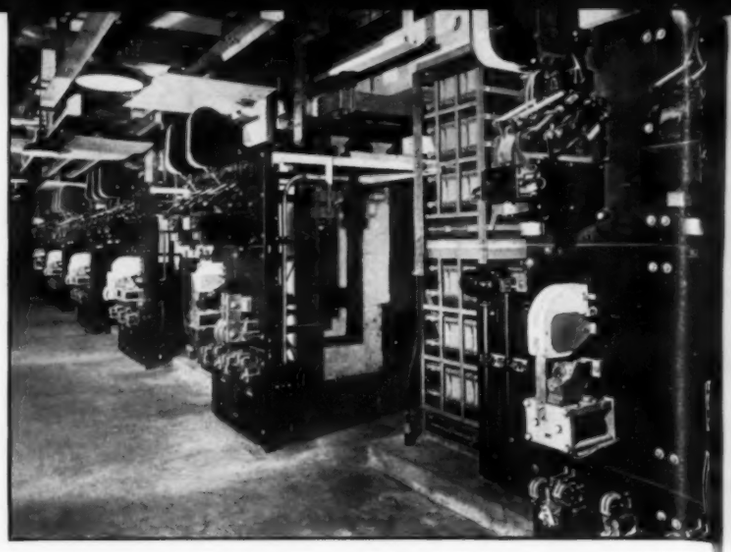
The guillotine type flying shear includes a 10-roll flattener and two pairs of feed rolls. Diameter of the flattening rolls is 5 5/16 in.

Following the flying shear is a motor-operated stationary type inspection conveyor, which carries the sheared sheets to the classifier and reject sheet piler, which is identical with that described later in detail for the cold-reduced sheet shearing line.

One-shot lubrication is employed for the processor, side trimmer and flying shear, in addition to the circulating lubrication systems that take care of the other units in the line.

Main drive of the processing uncoiler is a 100-hp, 230-volt d-c motor. The mandrel, cradle car, hydraulic pump and oil pump of the uncoiler are driven by 440-volt a-c motors, of 10, 5, 15, and one hp, respectively. Main drive of the side trimmer is a 40-hp, 230-volt d-c motor, with the housing adjustment of this unit powered by a 5-hp, 440-volt a-c motor. The main drive of the flying shear is a 100-hp, 230-volt d-c motor, with the lubricating pump and the roll adjustment being driven, respectively, by a 3-hp and two 1½-hp 440-volt a-c motors. The two belt conveyors are powered by 10-hp, 230-volt d-c motors. Main drive of the oiling machine is a 7½-hp, 230-volt d-c motor, and the oil pump drive of this unit is a one-hp, 440-volt a-c motor. All of the 440-volt a-c motors operate on three-phase, 60-cycle current, and are totally enclosed.

Resquaring and processing line—The resquaring and processing line is designed to operate at a maximum line speed of 175 fpm and to receive, resquare, scrub and pile sheets from the sheet shearing lines. Its capacity



This illustration in the cold mill basement shows, in series, the main breakers and auxiliary equipment for the generator and motor of each of the five stands of the five-stand, tandem, cold-reduction mill. The sixth breaker station at the far left serves the tension reel at the exit side of the mill, where cold-reduced steel strip is recoiled for further processing.

with respect to size and gage of material is the same as that of the shearing lines.

First unit in this line is a motor-driven skew table with seamless steel tubing rollers mounted in ball bearings with a gage plate side guide that feeds sheets to the side trimmer. The side trimmer is equipped with continuous feed and delivery conveyors. Knives of the side trimmer are 12 in. in diameter. A motor-driven unit cuts up the side scrap and deposits it in a scrap box. Following the side trimmer is a motor-driven belt type intermediate transfer table that carries the sheets to the end cut shear unit.

This is a double cut unit consisting of one fixed and one adjustable underdriven squaring shear, 60 in. wide, with an air operated friction clutch and brake. The shears are mounted on an adjustable base for adjusting to maximum and minimum lengths. An extension table supports sheets between the two shears.

A collapsible delivery table, adjustable for changing position of the adjustable end shear, consisting of a belt driven conveyor with pinch rolls at the entry end, carries material away from the squaring shear unit. This is followed by a motor-driven skew table with seamless steel tubing rollers mounted in ball bearings, having a gage side guide, that conveys sheets to a roller leveler. After passing through the leveler, the sheets are carried by a motor-driven belt type delivery table to the spray cleaning and scrubbing station.

The spray cleaning station consists of a two-section heavy duty steel tank, rubber lined, with mounted rubber rolls at the exit and entry ends of each section. Suitable acid resisting metal guides support and convey the sheets between the rolls. A series of spray units are mounted above and below the pass line to permit sufficient spray of acid solution in one section, and alkaline solution in the following section, over the entire surface of both sides of sheets passing through. The rubber covered rolls are 8 in. in diameter. A pumping unit for each section draws solution from the bottom of the tank and

pumps it to the sprays. This spraying station is followed by a scrubbing machine, where rotary brushes scrub the surfaces of both sides of the sheets.

Leaving the scrubber, sheets pass onto a dryer conveyor approximately 19 ft long, equipped with a heater and blower that directs warm air onto both sides of the cleaned sheets. An additional 23 ft of conveyor consisting of fiber discs mounted on steel shafts driven by double sprockets and staggered chain serves as a cooling conveyor. This conveyor is driven by a separate motor connected to a gear reduction unit by means of a flexible coupling.

Provision has been made in the line at the end of the cooling conveyor to accommodate the removable oiling machine described in connection with the sheet shearing line when it is required for oiling sheets. A replacement conveyor section is provided to carry sheets over this location when the oiling machine is not in the line.

The piler at the end of the resquaring and scrubbing line is identical with that employed on the 54-in. sheet shearing line.

Table drive of the skew table is a 5-hp, 230-volt d-c motor. Main drive of the side trimmer is a 20-hp, 230-volt d-c motor, while the housing adjustment is driven by a 3-hp, 440-volt a-c motor. Main drive of the scrap chopper is a 10-hp, 440-volt a-c motor. The intermediate transfer table is powered by a 5-hp, 230-volt d-c motor. Shear drives of the end cut shears are 5-hp, 440-volt a-c motors. Pinch roll drive on this unit is a 1½-hp, 230-volt d-c unit, while the cutting adjustment is a 5-hp, 440-volt a-c motor. Drive for the collapsible table is a 10-hp, 230-volt d-c unit, while a similar motor of 5-hp rating drives the second skew table. The roller leveler is driven by a 30/40-hp motor, using 230-volt d-c. Delivery table of the leveler is driven by a 5-hp, 230-volt d-c motor. Pump drives for the acid and alkali spray unit are 10-hp, 440-volt a-c motors. Motors for the scrubber are 20/25-hp, 230-volt d-c units. The dryer table and cooling conveyor are driven by a 5-hp, 230-volt, d-c motor. The blower for the dryer table is powered by a motor rated at 40-hp, operating on 440-volt alternating current. All of the 440-volt a-c motors are totally enclosed, and operate on three-phase, 60-cycle power.

Production of galvanized sheet — The galvanizing line in the new sheet and tin mill is an integrated installation consisting of pickling facilities, galvanizing pot, washer, dryer, and all auxiliary equipment, including roller levelers for flattening the coated sheets.

Designated as a 64-in. galvanizing line, the installation can handle sheets of maximum width up to 58 in., with a maximum length of 144 in., of thickness between 0.015 and 0.016-in. Operating speed can be varied between 10 and 135 fpm.

Before galvanizing, the sheets are pickled in a conventional rocker-type pickling machine, then neutralized and rinsed. The stacked sheets are then transferred to the two feed tables of the galvanizing line. These tables are constructed of welded steel sections, and run on tracks in the floor.

Sheets are fed first into an acid bath contained in a tank constructed of steel plate, rubber lined, provided with all the necessary housings, drives, rolls and guides for conveying the sheets through the bath. The exit rolls of this unit feed the sheets through a guide to the nipping rolls on the entry side of the galvanizing rig.

The galvanizing rig, which operates immersed in the molten zinc in the pot or kettle, has housings 4-in. thick, and is equipped with 8-in. diameter rolls with 64-in. faces for carrying the sheets through the process. It is supplied with the necessary guides and roll adjustments for accurately controlling sheet travel and coating quality. The separate drive for the galvanizing rig is mounted on a semi-steel movable base plate, and includes the couplings and gears required to connect the motors to the drive mechanisms. Altogether, the rig drive comprises three electric motors, of which two are 7½-hp and one 15-hp units, all operating on 230-volt direct current. The galvanizing kettle is built of special quality firebox steel, and is 97 in. wide, 136 in. long, and 60 in. deep.

The furnace setting is fired by 33 natural gas burners. Automatic temperature control equipment includes a two-point recording controller with automatic droop correction, a valve drive mechanism, air valve, and a regulator for controlling position of the stack damper. The combustion air fan is of 2000 cfm capacity at 16 oz pressure, operating at 1750 rpm. It is powered by a 15-hp, 440-volt a-c motor.

Setting above the base of the pot is constructed of first quality firebrick, insulated on the outside with 4½ in. of insulating brick. Below the base of the pot, second grade firebrick are employed, insulated with 5 in. of insulating brick. The furnace is completely encased in a structural steel frame, bound at the top with ½-in. steel plate tied to 6-in. buckstays. Fumes are exhausted from the pot location by means of a ventilating fan in a high-velocity hood, leading to a vertical stack about 28 ft in height.

As sheets emerge from the galvanizing pot, they are

Exit end of one of the two continuous electrolytic cleaning lines. This line can clean cold-reduced steel, in widths up to 54 in., intended for sheet production at speeds up to 2000 fpm. A similar line was installed to handle coils for tin plate up to 38 in. wide. The cleaning operation removes oil that accumulates during rolling from the surfaces of the strip steel, prior to annealing. Tightly-wound, cleaned coils are removed from the tension reel at the end of the line by an hydraulic stripper that pushes them onto the upender in the foreground. This unit rotates 90 degrees about a horizontal axis to turn the coil up on end, so that the fork of a lift truck can engage the coil and remove it from the line. Cleaning takes place in the rubber-covered tanks in the left background, the cleaned material being dried by heated air before it is recoiled.

deposited on the spangle conveyor, which is constructed of mesh belt supported on 7½ in. centers by oval rods carried on guide rails. This conveyor is about 25 ft in length, and has a 12-ft hinged section that permits quick removal of the front end of the conveyor from the line to give easy access to the rig for changing exit rolls. The conveyor is driven through a totally enclosed speed reducer powered by a 5-hp, 230-volt d-c motor. The frame of the conveyor is constructed of welded steel plates and shapes, and it is mounted on flanged wheels running in tracks in the floor so that the entire assembly can be rolled out of the processing line.

Following the spangle conveyor is the cooling conveyor, which is a mesh-belt unit approximately 30 ft long. It has a welded steel frame, and employs chain-type guides. Cooling air is furnished by a 40-hp fan operating on 440-volt a-c and rated at 36,000 cfm output at 3½ in. static pressure. The air is distributed over the sheets on the conveyor by suitable ducts.

The first roller leveler, immediately succeeding the cooling conveyor in the line, is a 9-roll unit of the worm-drive type, powered by a 20-hp, 230-volt d-c motor. Rolls are 4½ in. in diameter, with 66-in. faces, mounted on a welded and cross-braced steel base. This unit flattens sheets to minimize the possibility of scratches that might result from contact with the washing machine guides, and is especially necessary when heavy-gage sheets are being processed.

Following the first leveling operation, the sheets are conveyed to a washing machine, consisting of a large welded steel tank and equipped with one pair of driven rolls. Circulating steam and water used in the washing operation are subject to automatic control to regulate the temperature of the washing solution. Sheets emerging from the washer pass to a squeezer and dryer table. The squeezer roll unit has one pair of plastic rolls and one pair of rubber covered rolls, mounted in bronze bushings and driven by sprockets and chains from the drive shaft of the washer. The dryer table has a welded steel frame, with a series of plastic wheels mounted on pillow blocks, driven from the washer by sprockets and chains, and equipped with a blower that supplies drying air to the sheets through top and bottom blast ducts. The blower is driven by a 7½-hp, 440-volt a-c motor.

After washing, the galvanized sheets are passed through a second roller leveler in the line, which is a 17-roll unit of the worm-drive type. The drive for this machine is a 20/25-hp, 230-volt d-c motor. Rolls are 4¼ in. in diameter, with a 66-in. face. Base of the leveler is built of welded and cross-braced rolled steel sections. An oil reservoir and gear pump furnish a continuous oil bath to the worm and gear drive of the rolls.

An inspection table of welded steel construction in conjunction with approximately 30 ft of gravity runout conveyor in 10-ft sections completes the galvanizing line.

PRODUCTION OF ELECTROLYTIC TIN PLATE

Annealed coils of cold-reduced steel for production of tin plate by the electrolytic method are first rolled in temper mills to produce a superior surface and impart desirable physical characteristics. This rolling is performed in either of two two-stand tandem four-high mills. The cast-steel housings of these mills have a post area of 710.5 sq in. Window liners are ¾-in. thick. The work rolls are 18 in. in diameter with a 42-in. face, and are equipped with four-row roller bearings 8 in. in inside diameter. Back-up rolls are 49 in. in diameter and have radial oil-flooded sleeve bearings and roller thrust bearings. No. 1 stand of each mill is driven by a 500-hp motor and No. 2 stand by an 800-hp motor, both of 600-volt d-c and with a maximum operating speed of 700 rpm. A tensiometer is installed at the entry side on No. 2 stand of each mill. Mill spindles are of forged steel, and are equipped with a spring-balanced carrier.

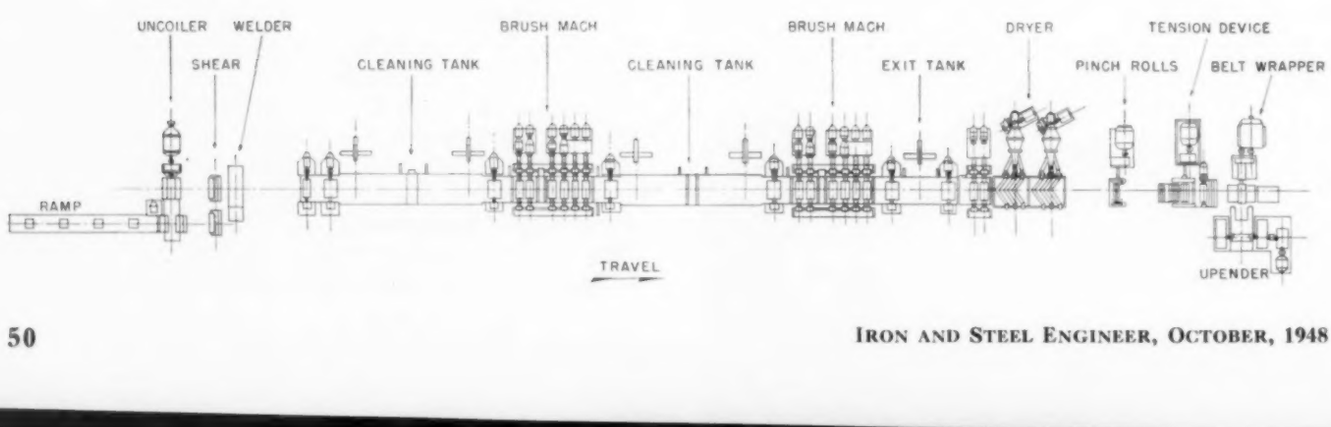
Two tension roll units have been provided on each temper mill, one at the entry side of No. 1 stand and the other at the delivery side of No. 2 stand. The tension reel for each mill has a 20-in. diameter collapsing drum built up of cast steel sections, and is overhung mounted. It is motor-driven through a gear reduction unit. The reel incorporates a hydraulically operated stripper mechanism.

The temper mills each have a maximum finishing speed of 3000 fpm and are designed to handle 30,000 lb cold-reduced and annealed mild steel coils, 16-38 in. wide, and 0.060 in. 0.006 in. in thickness. Coils are 20 in. diameter and may be up to 60 in. in outside diameter.

Tin plate side trimming and recoiling lines—Cold-reduced, annealed, tempered coils which are to be tin plated electrolytically are first passed through a side trimming and recoil line to cut the product to exact width. This line has a capacity for handling coils from the temper mills at a maximum speed of 1800 fpm. Following the side trimmer is an air-operated shear which cuts off the crop ends of the coils. The shear is followed by a travelhead series seam welder.

As the material emerges from the welding station, it

Plan of 54 in. electrolytic cleaning line.

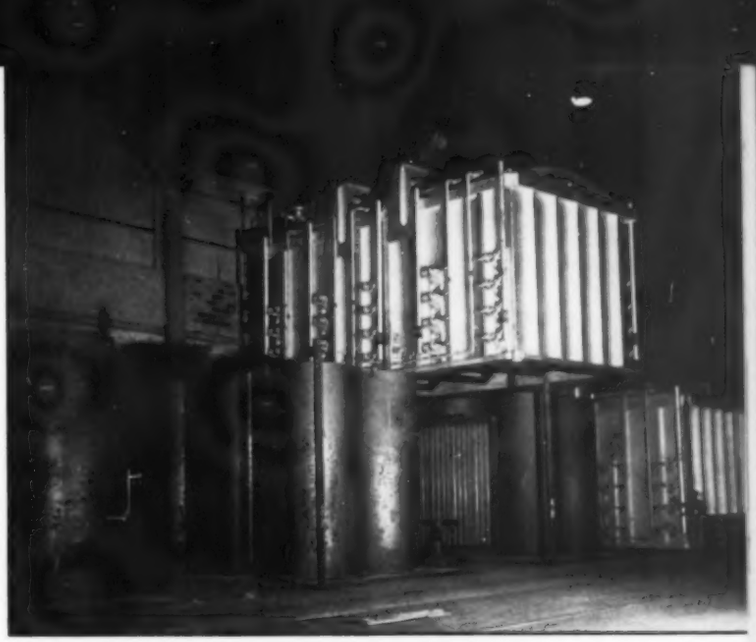


is paid off into a loop by pinch rolls. Following the loop is a tension bridle, from where the product is coiled on a tension reel that can wind tight coils weighing up to 30,000 lb.

Electrolytic tinning unit—The continuous electrolytic tinning line is somewhat over 250 ft in length. At the entry end, two coil holders, various pinch rolls and guides, a double cut shear, and a welder precede a 60-ft looping pit. This pit affords slack that permits the tinning line to operate continuously while the coil is momentarily stopped at the entry end to permit welding of successive lengths and also provides a length of tension-free material that enables it to be fed accurately into the tinning line.

The uncoated product first passes in vertical loops through successive cleaning, rinsing and pickling solution through a brushing and rinsing machine where pickle salts and solution are removed, and thence into the first of the four electroplating tanks. As it emerges from the fourth plating tank, it is rinsed and passes to a vertical muffle furnace where it is heated until the tin coating melts. It is then quenched in water, after which it runs through a chemical treating unit and then through an emulsion oiling machine.

The tinned product next passes over a hump conveyor into a combined roller leveler and rotary flying shear which cuts it into ordered sizes. The sheared tin plate passes from the shear directly to the classifying conveyors, where it is sorted into three lots: off-gage plate, menders and prime plate. The prime plate is counted into desired size bundles and carried away from the tinning line classifier on a roller conveyor at right angles to the line. The prime bundles of plate are weighed on a scale on this conveyor and are then packaged for shipment. The tinning line can produce tin coated material 0.007-0.0143 in. thick, 18-34 in. wide and up to 37½ in. long, at speeds up to 600 fpm. Plate from the off-gage and mender pilers are transferred to a reclassification line for further inspection and necessary extra treatment or special disposition.



One of the cover-type annealing furnaces being lowered over eight stacks of cold-reduced coils of steel at the start of the annealing process. Ten annealing furnaces with thirty bases have been installed in the annealing department for heat treating steel to be processed into sheet steel, electrolytic and hop-dip plate, galvanized sheets and terne plate.

HOT-DIP TINNING

Hot-dip tinning operations are carried out on individual sheets instead of on continuous lengths from coils as in the case of electrolytic tinning. Shearing of the cold reduced, annealed and tempered coils into sheets is effected on three identical tin plate shearing lines. Each of these lines incorporates all of the components necessary for coil handling, side trimming, shearing to length and piling.

The rotary flying shear of each line is suitable for cutting 22-38 gage material with a length range of 19-42 in. at speeds up to 1000 fpm. Three shear heads are all that are required to cover the complete range.

Following the rotary shear in each line is a classifier, including belt conveyors and pilers, to segregate material into prime and reject piles. Piles are formed on skids arranged for entry on one side and exit on the other side, actuated by an air-operated pusher. Each shear line is equipped with a flying micrometer and a photoelectric pinhole detector.

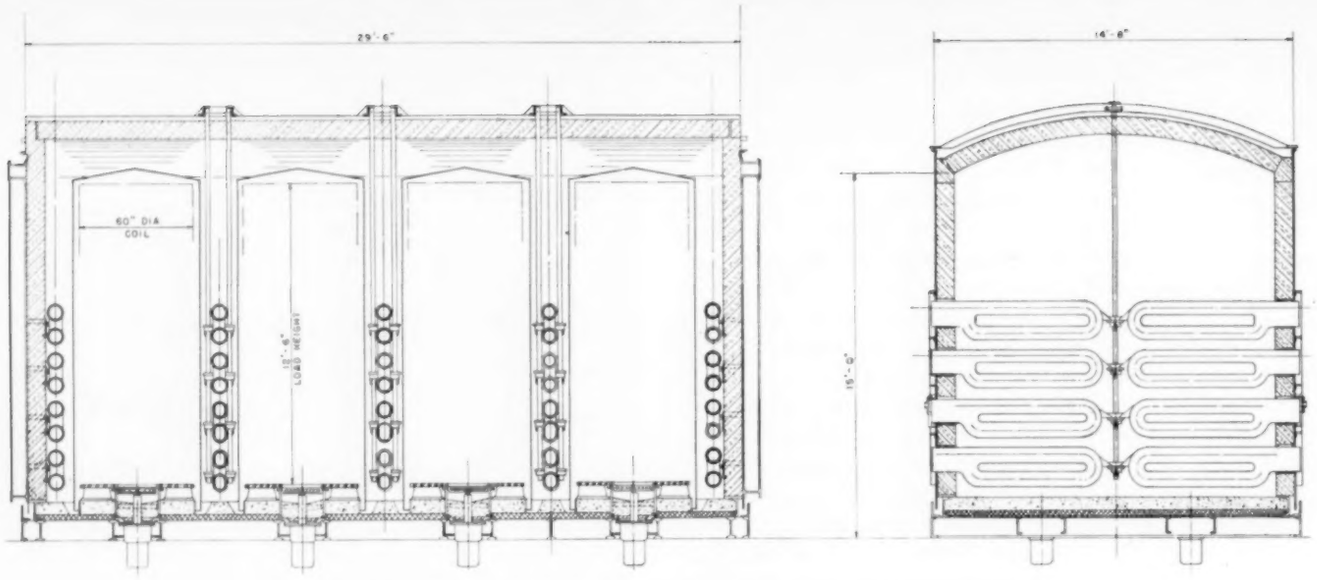
Hot-dip tinning units and auxiliaries—The new plant has a total of fourteen hot-dip tinning units complete with auxiliary equipment. These lines will process tin plate between 16 and 36 in. wide, 20-36 in. long, and between 26 and 38 gage in thickness. Maximum weight of pile that can be accommodated by the handling equipment at the entry end of the lines is 12,000 lb. Prime coated plate is automatically reckoned and piled in specified quantities for packaging, warehousing, and shipping. Each of the fourteen 75-in. wide coating units consists of an entry conveyor, automatic feeding unit, electrolytic pickling unit, tin pot and setting, tinning feeder and tinning machine, catcher and conveyor, washer, and cleaner, followed in each case by a mechanical assorting, reckoning and piling line.

Supplementing the fourteen coating units, the installation includes a 45-in. recleaning line consisting of a hydraulic hoist, a 1⅝-in. diameter backed-up type roller leveler, a washer, a cleaner and a piler.

Automatic firing equipment for the fourteen tin pots is supplied with desired natural gas-air mixture by two industrial-type carburetors, each with a capacity of 120,000 cfhr of proportioned mixture. Air is supplied to the carburetors by turbo-compressors driven by a 30-hp, 1800 rpm totally-enclosed, fan-cooled, explosion-proof squirrel-cage motors. Two electrostatic precipitators remove dust from air supplied to the carburetors.

Each tin pot is heated by two immersion-type elements. In addition, a high-pressure inspirating-type gas burner is installed on the palm-oil side of the pot for supplementary heating of the palm oil when required. Tin bath temperature is controlled in each pot by a single-point indicating and recording controller. A similar temperature control system regulates palm oil temperature on each pot.

A soda ash mixing and distributing system delivers detergent solution to each of the washers as required. The system consists of a steel tank where the soda ash is dissolved in a measured amount of water, together



Longitudinal and cross sections through hood type annealing furnace.

with necessary metering and distribution equipment to provide required flow into each tinning line washer. A washer waste liquid system handles the overflow from the wet washers and consists of a system of open troughs, a neutralizing plant, and separation tanks for separation of oil from neutralized solution. A steam jacketed sludge pump is installed to provide disposal.

An acid mixing system automatically feeds dilute acid to each pickling unit. The dilute acid is stored in two 100 gal rubber-lined tanks. Rubber-lined piping connects the dilute acid mixing system and the feeding system to each of the electrolytic pickling units preceding each tin pot. The waste acid system consists of a common drain line from each pickling unit discharging through rubber-lined pipe.

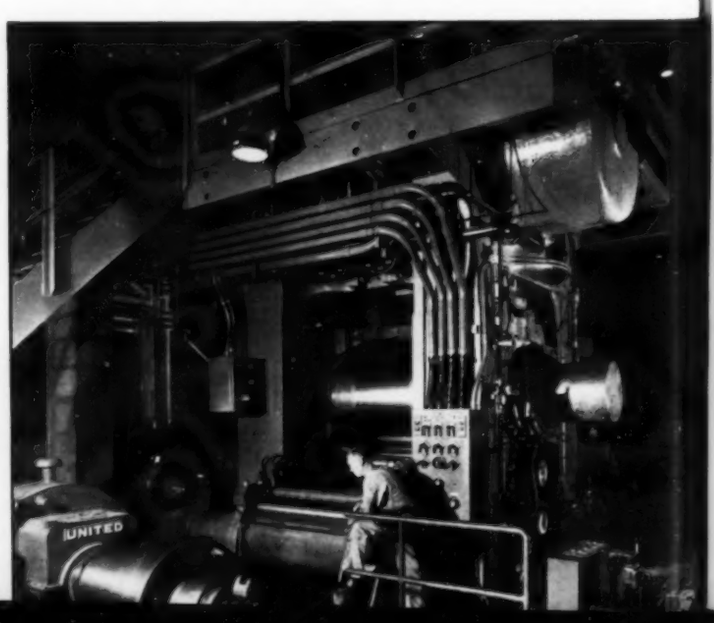
Facilities for processing scruff to recover metallic tin include a furnace and a scruff crusher. The crusher has rolls 12 x 12 in. driven by V-belts powered by two 3-hp motors, and a vibrating screen driven by a one-hp motor. Both motors are totally enclosed, fan cooled, squirrel-cage types. Combustion air for the gas-fired scruff furnace is supplied by a blower. Firing is controlled by a combination air-gas, manually operated valve. The furnace stack is brick lined. A cast iron gas-fired pot and molds are provided for casting the recovered tin into anodes for the electrolytic tinning operation.

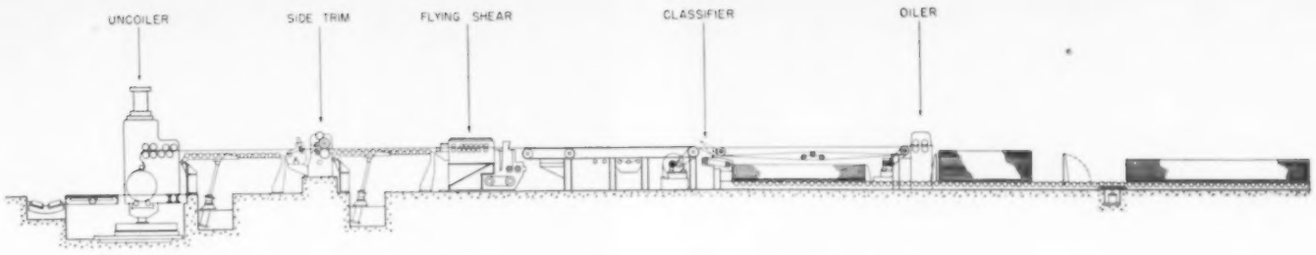
Mechanical assorting, reckoning and piling lines—Supplementing line classification performed on the 14 hot-dip tinning lines and on the electrolytic-tinning line, two separate reclassification lines are installed for necessary reinspection of a portion of the product. Except for special feeding provisions on the separate lines, they are similar to the mechanical assorting, reckoning, and piling assemblies in tandem with the hot-dip tinning equipment.

All sixteen of the lines include an inspection device consisting of a five-section, seven-armed wheel, with smooth surfaces that will not damage the surface of the tin plate. This wheel rotates in anti-friction bearings with a through shaft directly connected to a hydraulic or electric drive motor. The wheel has a speed of approximately 9 rpm. The fingers of the wheel come up between the rollers of the entry conveyor to lift the plate, turn it over, and lower it onto the exit V-belt conveyor. A mender and a waste-waste control are provided at this location so that a classifier, after inspecting both sides of a sheet, can divert it either to the mender or the waste-waste pile, if necessary. If neither classification is made, the sheet automatically goes to the prime pile. To effect diversion to the mender and waste-waste pilers, each line is equipped with two solenoid-operated deflector gates.

Classification into three groups (primes, menders,

Exit side of the sheet temper mill. This mill is a single-stand unit, driven by a 1000 hp, 600-volt d-c motor, with a maximum operating speed of 600 rpm. Steel can be rolled at speeds up to 1000 fpm in coil form. Special auxiliary equipment makes possible the temper rolling of individual sheets when desired. This mill can roll products up to 52 in. wide.





Elevation through auxiliary sheet shearing line.

and wasters) requires three pilers for each of the sixteen lines. Each piler has side guides and an end stop to assist in maintaining a uniform, square pile. Prime piler hoists are electrically operated. All parts are above floor level. Provisions have been made to permit a new prime bundle to be started while a finished bundle is being removed from the prime piler. A counter tallies the prime sheets as they are piled, and automatically resets to count successive bundles.

Conveyors are used to carry sheets forward in single file between the individual units of the classifying lines. The first of these, a belt-driven roller conveyor provided in conjunction with the hot-dip tinning lines, is approximately 9 ft long and carries sheets, at right angles to the direction of tinning, from the cleaner exit into the inspection wheel.

Inspection wheels of the separate reclassification lines are fed by four strands of V-belt. The spokes of the inspection wheels come up between these strands to turn over the individual sheets for inspection of both sides.

The remaining three conveyors, operating with the piler, are 4 ft 10 in., 5 ft 3½ in., and 5 ft 10¾ in., respectively, from the center line of head shaft to the center line of tail shaft. The first two employ two 10-in. wide endless flat belts set on 14-in. centers, the third employs two 7-in. wide endless flat belts set on 11-in. centers.

All conveyors are driven from a common drive located at the exit end of the first belt conveyor of each line. This drive consists of a totally enclosed gear reduction unit with chain drive from the low-speed shaft to the driving pulley of the belt conveyor. Approximately 35 ft of gravity roller conveyor are provided beyond each prime piler, feeding directly to individual 8000 lb scales. Roller conveyor runout is also provided beyond each scale to permit packaging of completed bundles before tractor pick-up. Mender and waste-pilers are equipped with pneumatically-ejected buggies which move plate out at right angles to the line for tractor pick-up.

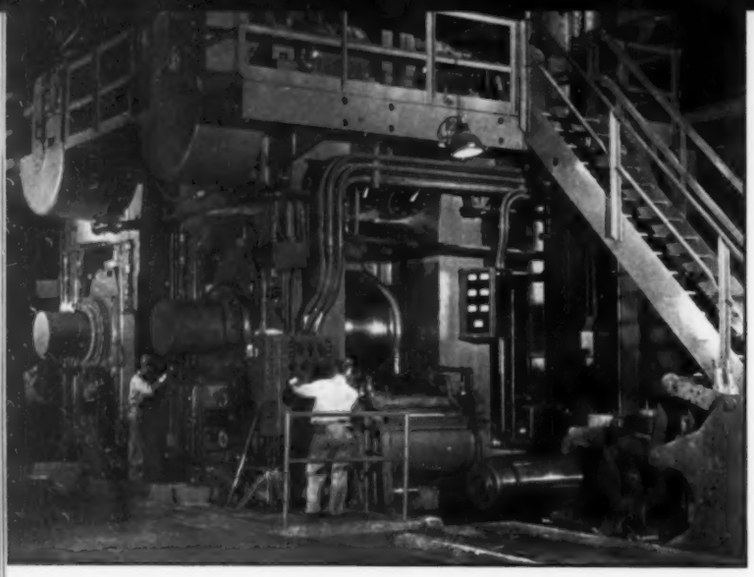
WATER SUPPLY

Purified water for use in critical processes such as electrolytic tinning, pickling, and other operations requiring close control, is obtained from a new clarification and filtration plant. Water treated here originates in the San Joaquin River, and comes from a canal forming part of the Central Valley Water Project. This water contains relatively large amounts of impurities that must be removed before the water becomes suitable for use in processes requiring close control.

Water intake for the plant is through an 18-in. line from the canal. A venturi-type flow meter in the line provides continuous indication and permanent record of water intake. The metered water passes through the clarifier, 100 ft in diameter x 12 ft deep, where measured amounts of sulphate of iron and lime are continuously added at a rate commensurate with the flow of water through the clarifier. The water in the clarifier is constantly agitated and aerated to promote the chemical reactions that result in flocculation, coagulation and sedimentation of the impurities. These settle out of the water, and are removed from the bottom section of the clarifier by a sludge pump.

Clarified water passes out of the clarifier over effluent weirs, where it is chlorinated, and to a deep, rectangular

Control station for one of the galvanizing lines. In the left background is the galvanizing pot containing molten zinc into which sheets are fed and conducted through the bath by suitable mechanisms. Emerging from the pot, the zinc-coated sheets are deposited on the wire-mesh conveyor, where they cool and the molten zinc solidifies to produce the spangled surface characteristic of this product. Succeeding units then wash, dry and flatten the sheets, which are then delivered to a piling station, where they are inspected, stamped for identification, tallied and piled.



Annealed coils of cold-reduced steel for tin plate are rolled in either of two-stand temper mills of the type shown here to produce a superior surface and impart desirable physical characteristics to the steel. This shows the exit side of one of the mills. The No. 1 stand at the entry side of the mill is driven by a 500-hp motor, and the No. 2 stand at the exit side by an 800-hp motor. Work rolls are 18 in. in diameter, with a 42-in. face, while the back-up rolls are 49 in. in diameter.

Control basement for the south two-stand tin temper mill. Front of the control panels is shown at the left, with motor-operated rheostats for control mounted on the structure behind the control panels, and the rotary power-regulating equipment along the wall in the rear. The latter consists of six generators of various characteristics, driven by one motor. Outputs of the generators are applied in various ways to the fields of motors and generators of the mill drives for the purpose of maintaining constant mill speeds under varying loads.

concrete well, adjacent to the four concrete tank gravity-type filters, each 24 ft x 18 ft. Water for the new sheet and tin mill, and for the rod mill that was added to the original plant in 1942, then passes through the filters, is collected beneath the filter units, and pumped by two 4000-gpm, 175-ft vertical turbine pumps to a new, overhead storage tank. This tank has a hemispheroidal top and bottom and straight sides. It is 40 ft in diameter, 30 ft in maximum height, and has a capacity for 250,000 gal of treated water. Water for other departments of the plant is clarified but not filtered and is pumped directly from the clarified-water reservoir into plant water lines leading to storage units of the older installations.

Piping is arranged so that the clarifier can be bypassed when maintenance or repair work is required.

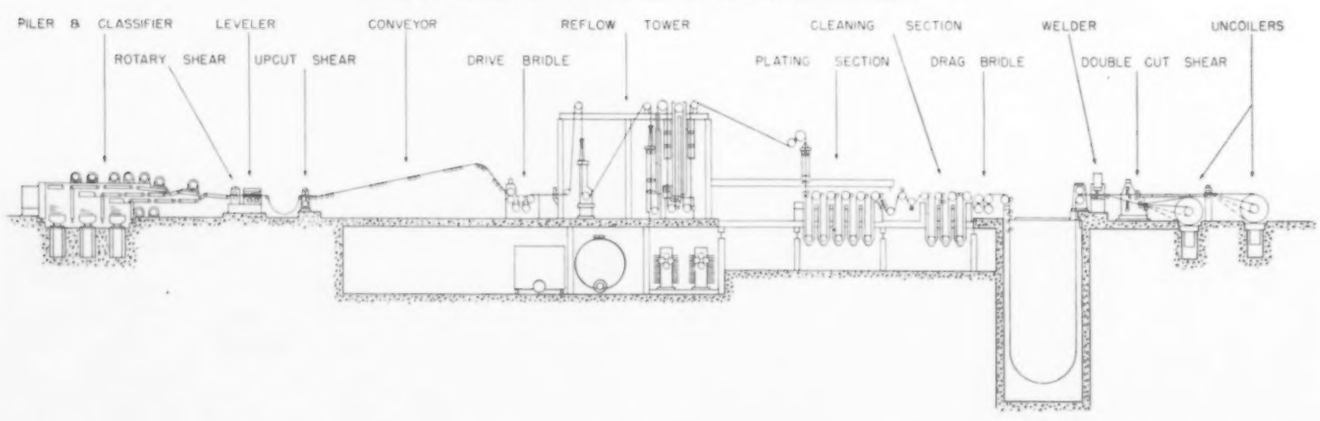
City water is used in all locations in the plant for drinking purposes. Water from the filtration plant is used in the sanitary building for washing and similar purposes. Ordinary cooling water is pumped from the New York Slough, on which the plant property abuts, and is screened before use.

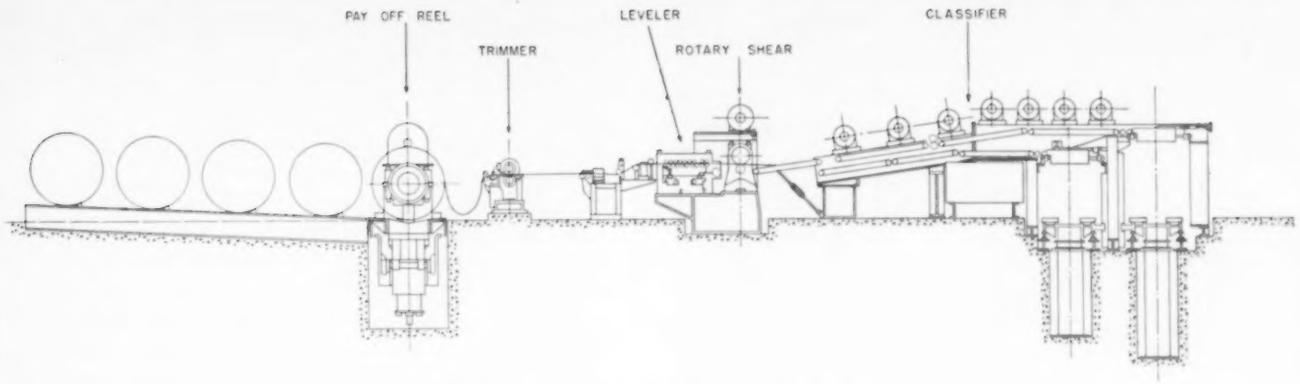
STEAM GENERATING PLANT

The new steam generating plant consists of two four-drum boiler units, each designed to supply a continuous output of 58,000 lb of saturated steam per hr for a minimum two-hour period. Built in accordance with the latest code, the two boiler units were designed for 200 psi gage pressure, with an operating pressure of 175 psi gage.

Three combination gas and oil burners fire each boiler. Steam is used for oil atomization. Efficiency of

Sectional elevation through electrolytic tinning line.





42 in. continuous tin plate shearing line.

the combustion system is 75 per cent on gas firing, and 82 per cent on oil firing. The stacks are of the self-supporting type, braced with structural steel framework.

Induced draft fans for the boilers have steam turbine drives with built-in gear units. Capacity or each blower matches the maximum capacity of the boiler units with a 25 per cent margin.

Two-stage centrifugal pumps supply feedwater to the boilers. These have direct-connected steam drives, and each pump has a capacity sufficient to supply the two boilers operating at maximum capacity. The feedwater heater is heated by exhaust steam from boiler auxiliaries, supplemented by live steam. Capacity of the heater is based on 100 per cent cold water make-up for the two boilers at full capacity. Feedwater supply is automatically regulated.

The feedwater conditioning system consists of a double-unit softening installation that is automatic in operation. It utilizes two zeolite tanks 84 in. in diameter and 66 in. deep, and also involves a phosphate feeder and an automatic lime-soda feeder. Capacity of the boiler feedwater conditioning system is sufficient to meet the needs of both boilers operating at full capacity.

Instruments and controls that regulate operation of the plant include a combustion control for regulating fuel-air ratios on 100 per cent gas or 100 per cent oil firing. There are two electric recording and integrating steam flow meters, an integrating and recording gas flow meter, two three-point draft gages, and all other temperature and pressure gages and control units required for good boiler practice.

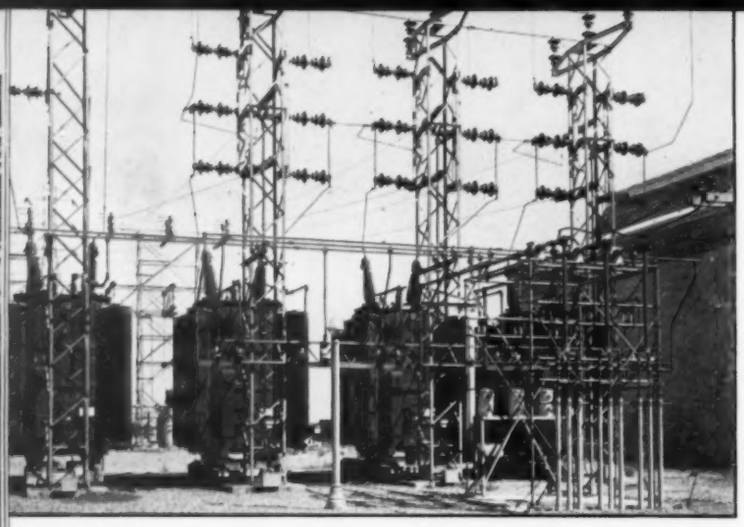
Two two-stage rotary air compressors have also been installed in the boiler plant to supply compressed air for the new sheet and tin mill. Each compressor is driven by a 350-hp, 2300-volt synchronous electric motor. Two 54-in. diameter air receivers, each 14 ft high, are provided. The two aftercoolers of the air system have corrosion-resisting tubes and tube sheets, and incorporate moisture traps and oil separators.

POWER DISTRIBUTION SYSTEM

The new facilities represent an electrical load of approximately 30,000 kva. All processing lines with the exception of the hot-dip tinning lines and the auxiliary sheet-shearing line, which is a resquaring and scrubbing line, have the adjustable voltage system of control. Power for the hot-dip tinning units and the resquaring line is from 250-volt d-c shop lines.

The 6.9-kv feeders, which are varnished cambric insulated, lead covered cables, have 7500-volt insulation. For the 2.3-kv feeders, insulated and covered in the same manner, it is 5000-volt insulation. For underground applications, 440-volt a-c and 250-volt d-c feeders are varnished cambric insulated, lead covered cables having 600-volt insulation; varnished cambric, double braided, 600-volt insulation is provided when the circuits are overhead or when exposed. All conduit is rigid steel conduit except in the underground duct system where the conduit is transite or transite korduct. All the processing lines where the adjustable voltage system of control is employed are supplied with 250-volt d-c emergency excitation. The voltage and horsepower rat-

Side view of one of the fourteen mechanical assorting, piling and reckoning lines for hot-dip tin plate. Sheets emerge from the branner at the exit side of the tin pot at the right of this illustration, and proceed by conveyor to the inspection wheel where an operator inspects both sides of each sheet as the wheel automatically turns over the sheet and then deposits it onto the conveyor of the assorting, reckoning and piling line extending to the left. By pressing a button the inspector can deflect sheets to one of two piles for off-grade material, or allow it to travel to the end of the line where prime plate is piled.



These four 10,000 kva, 110–6.9-kilovolt transformers (one of which is a spare) supply power to the new sheet and tin mill. The power used is distributed to production units from two substations inside the plant buildings, one located in the cold-mill motor room and the other in the power rectifier station. Potential transformers for metering are visible at the right, in the foreground.

ing of the motors on the various processing line main motor-generator sets are:

Line	Motor horsepower	Voltage
Tin temper mill (North)	2970	6900
Tin temper mill (South)	2970	6900
Five-stand cold mill (Motor-generator set No. 1)	6600	6900
Five-stand cold mill (Motor-generator set No. 2)	13,300	6900
Single-stand sheet temper mill	2500	6900
Electrolytic tinning line	500	6900
54-in. continuous pickler (Motor-generator set No. 1)	400	2300
54 in. continuous pickler (Motor generator set No. 2)	400	2300
38 in. electrolytic cleaning line	400	2300
54 in electrolytic cleaning line	500	2300
Auxiliary sheet shearing line	300	2300
Side trimming and recoil line	250	2300
Tin plate shearing line No. 1	150	440
Tin plate shearing line No. 2	150	440
Tin plate shearing line No. 3	150	440
Cold-reduced sheet shearing line	150	440
64 in. galvanizing line	75	440

6.9-kv incoming line—Power for the new sheet and tin mill is supplied from the No. 2 utility substation extension which consists of four 10,000-kva, 110/6.9-kv transformers, one of which is a spare. The utility company supplies power from the transformer bank to their metering structure. Nine single conductor 1,000,000 cir mil cables are run underground in nine 3-in. transite conduits from the metering structure to a 2000-amp dummy breaker in the Columbia Steel Company portion of the No. 2 substation. This dummy breaker is a section of the outdoor metal clad switch gear.

The power used in the mill is distributed from two substations inside the plant buildings, one located in the cold mill motor room and the other in the power rectifier station. The motor room incoming line feeder originates from a 2000-amp breaker in the No. 2 substation and terminates at a 2000-amp dummy breaker in the cold mill motor room. This feeder consists of six 3-conductor 500,000 cir mil cables in six 4-in. transite conduits.

6.9-kv switch gear at cold mill motor room—Ten feeder circuits branch out of the 6.9-kv switch gear in the cold mill motor room from 1200-amp breakers. The first is a feeder line between the cold mill motor room and the power rectifier station and consists of two 3-conductor, No. 4/0 cables in separate conduits.

The second line runs from the motor room to the 6600-hp motor of No. 1 motor-generator set of the cold-reduction mill. This line consists of two 3-conductor 500,000 cir mil cables. A third line runs to the 13,300-hp motor of motor-generator set No. 2 of the cold reduction mill. This line consists of three 3-conductor 500,000 cir mil cables.

The fourth line runs to the entrance compartment in the tin temper mill basement and consists of one 3-conductor 500,000 cir mil cable in a 4-in. conduit. From a 1200-amp breaker at the north tin temper basement a line runs to the 2970-hp motor of the motor-generator set of the north tin temper mill. This line is a single 3-conductor 350,000 cir mil cable in a 4-in. conduit circuit. A similar line runs to the south tin temper motor generator set.

The fifth circuit runs to the entrance of the sheet temper mill basement. This line is a 3-conductor No. 4/0 cable in a 4-in. conduit. From a 1200-amp breaker in the sheet temper mill basement, a line consisting of a 3-conductor 350,000 cir mil cable in 4-in. conduit runs to the 2500-hp motor of the sheet temper mill motor-generator set. The sixth line runs to a 2500-kva, 6900/2300-volt power transformer in the cold mill motor room. This is a single 3-conductor, No. 4/0 cable in a 3½-in. conduit. A similar circuit runs to a 2500-kva 6900/2300-volt lighting transformer in the cold-reduction mill motor room. An eighth circuit feeds a 2000-kva 6900/440-volt power transformer in the cold mill motor room and consists of a single 3-conductor No. 4/0 cable running in a 3½-in. conduit. The ninth circuit goes to 1690-kva rectifier transformer No. 1 at the cold mill motor room. This also is a single No. 4/0 cable of the 3-conductor type, running in a 3½-in. conduit. The last circuit branching out of the 6.9-kv switch gear in the cold mill motor room supplies 1690-kva rectifier transformer No. 2 in the cold mill motor room, through a single 3-conductor, No. 4/0 cable running in a 3½-in. conduit.

6.9-kv switch gear at power rectifier station—There are three main feeder circuits carried in 3-conductor No. 4/0 cables in 3½-in. conduits. These all branch out of the power rectifier station through 1200-amp breakers. The first runs to a 1200-amp incoming line breaker in the electrolytic tin line basement. From the incoming line breaker there are two lines, one of which supplies power to the 500-hp motor of the motor-generator set of the electrolytic tinning line. The other branch runs from the breaker in the electrolytic tinning line basement to the electrolytic tinning line, where it supplies power to two 500-kva single-phase transformers and two 500-kva single-phase reactors as well as a 75-kva, single-phase electric-furnace transformer. The second main feeder line runs from the breaker to a 2000-kva

6900/440-volt transformer at the power rectifier station. The third main line runs from the breaker to a 1690-kva rectifier transformer at the station.

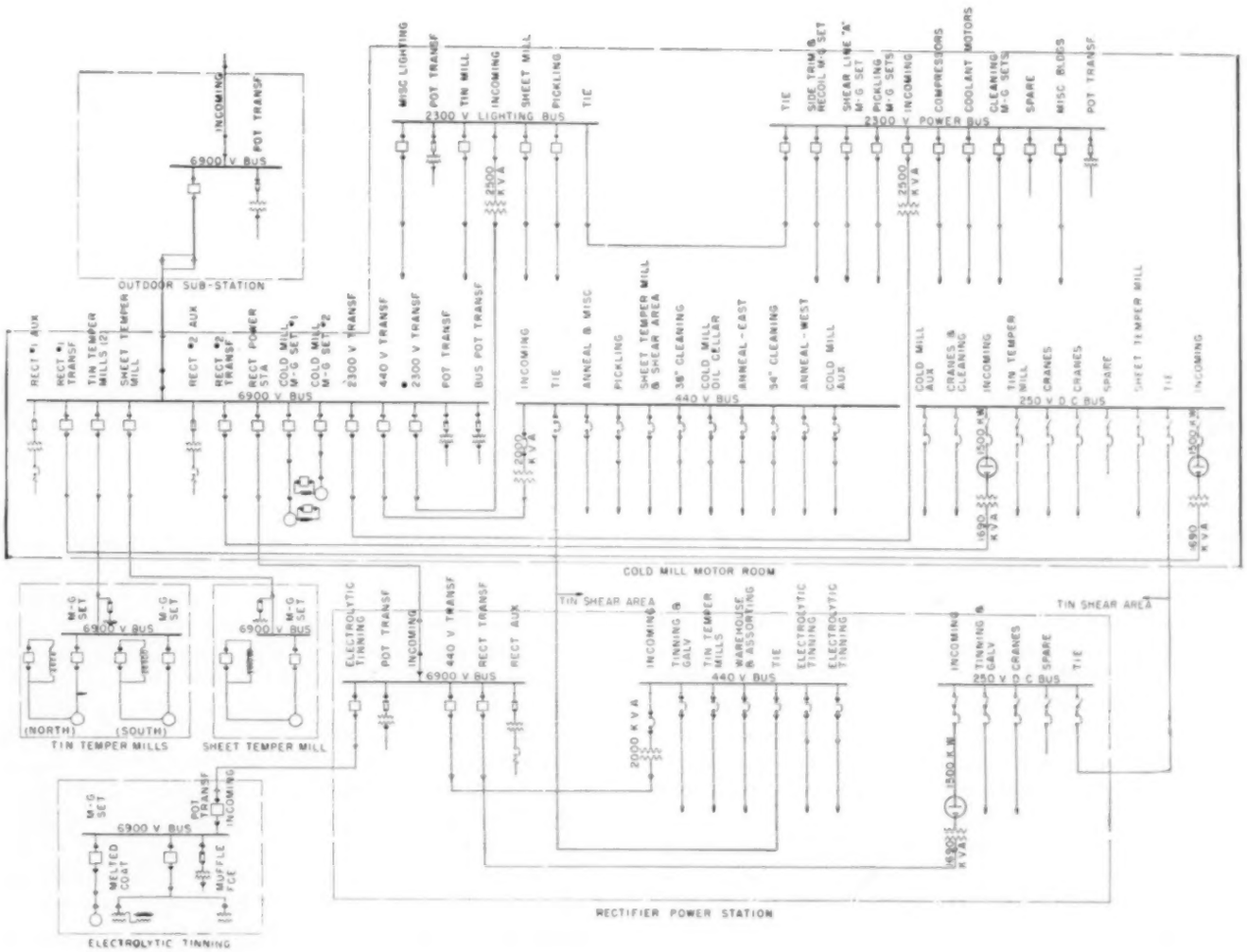
2.3-kv power unit substation in the cold mill motor room—The incoming line to the 2300-volt power unit substation in the cold mill motor room is from a 2500-kva 6900/2300-volt transformer in the motor room to the 1200-amp incoming line breaker. Eight feeder circuits emerge through 600-amp breakers from the power unit substation. The first runs from the power unit substation to the administration building, hospital, industrial relations building and yard area, and furnishes both power and lighting current to the above area.

From the power unit substation, a second line runs to the 300-hp motor of the motor-generator set of auxiliary sheet shearing line A by way of the synchronous motor starter. A third circuit runs to the 250-hp motor of the side trimming and recoiling line motor-generator set through the synchronous motor starter. The fourth line runs from the substation to a three-way "tee" splice box. Two branch lines leave the splice box: one to the 500-hp motor of the motor-generator set of the 54-in. cleaning line by way of the synchronous motor starter; the second branch runs to the 400-hp motor of the motor-generating set of the 38-in. cleaning line by way of the synchronous motor starter. The fifth 2.3-kv circuit from the power unit substation in the cold mill motor room runs to synchronous motor starters Nos. 1 and 2 for the two 400-hp motors of the motor-generator sets of the pickling line. The sixth line runs to a cubicle at the boiler plant, from where separate lines run to each of the 350-hp motors which operate the air compressors. The seventh line runs to 400-hp oil coolant motors in the motor room oil cellar by way of the synchronous motor starters. The eighth line is a tie between the power unit substation and lighting unit substation.

2.3-kv lighting unit substation—The incoming line for the 2300-volt lighting unit substation at the cold mill motor room is from a 2500-kva 6900/2300-volt transformer at the motor room to the incoming line compartment at the lighting unit substation. Four feeder circuits emerge from the lighting unit substation through 600-amp breakers. The first runs to the gate house, vaults Nos. 1, 4, 7, and 8, the track scale house, change house, yard, fence and dock area. The second circuit supplies the sheet mill area. The third line runs to the pickling area, including the cold mill motor room, oil cellar, annealing basement, and four lighting platforms. The fourth circuit supplies the tin mill area.

440-volt unit substation—The incoming line for the

Diagram of power distribution system.



440-volt unit substation in the cold mill motor room is from the 2000-kva 6900/440-volt power transformer at the cold mill motor room to a 4000-amp breaker in the 440-volt unit substation. Ten feeder circuits leave this substation, all but one through 800-amp breakers. The first goes to the 440-volt incoming line panel for the 38-in. cleaning line. The second line runs to an 800-amp breaker at the power rectifier substation, and serves as a tie line between the cold mill motor room and power rectifire station, as well as supply power for the roll blast, black plate assorting line No. 1, roll grinder, three tin plate shearing lines and the side trimming and recoil line. The third line runs to the incoming line panel for the 54-in. cleaning line.

From the unit substation, the fourth line runs to the pickling area and supplies power for acid pumps, boiler plant, motor-operated doors, pickle line, sump pumps, the 54-in. pickling line, acid pit pumps and an overhead traveling crane. The fifth line runs to the west annealing area and supplies power for the annealing base fans and one of the controlled atmosphere gas generating houses. The sixth line supplies the annealing department roof ventilators, battery charging station, a crane, etc. The sheet temper mill and auxiliary sheet shearing area are served by the seventh circuit, which also supplies coil down-tilters, the single-stand sheet-temper mill, roof ventilators, batch pickler, auxiliary sheet shearing lines, cold-reduced sheet shearing line, motor operated doors and acid pump. The eighth line is from a 1600-amp breaker at the unit substation to the controls at the cold mill motor room for cold mill auxiliaries. A ninth circuit runs to the east annealing area and takes care of the annealing base fans, the second controlled atmosphere gas generating house, etc. The last circuit emanating from the unit substation goes to the cold mill oil cellar.

440-volt unit substation at power rectifier station—The incoming line for the 440-volt unit substation at the power rectifier station is from the 2000-kva 6900/440-volt power transformers at the power rectifier station to a 4000-amp breaker in the 440-volt unit substation. Six feeder circuits emanate from the 440-volt unit substation. The first is the tie line circuit included in the unit substation in the cold mill motor room previously mentioned. The second circuit is from a 1600-amp breaker to the hot dip tinning units, palm oil cellar, flux house, scruff house, sal ammoniac room, 64-in. galvanizing line, two cranes and the black sheet oilers. The third line is from an 800-amp breaker to the two tin temper mills and three cranes in that area. The fourth circuit is from an 800-amp breaker to the warehouse and assorting area, which includes the tin house machine shop, gas mixers, branner make-up fan, a crane, motor-operated doors, miscellaneous equipment in the galvanized sheet warehouse, plant restaurant, a black plate assorting line, three fan rooms, and the fume exhaust stack fan. The fifth line runs from an 800-amp breaker at the unit substation to the electrolytic tinning line, and the sixth runs from a 1600-amp breaker to the electrolytic tinning line rectifiers.

250-volt metal-clad switch gear in cold mill motor room—The incoming line for the 250-volt switch gear in the cold mill motor room is from two 1500-kw, 250-volt rectifiers in the room to two incoming line breakers.

Interior view of control basement. Looking over the motor-generator sets in the right foreground can be seen the variable-voltage control panel for the pickling line. This room also contains 2300-volt switch gear that is not visible from this vantage point.

Seven feeder circuits emerge from this switch gear through 2000-amp breakers. The first is to three of the cranes in the cold reduction department. The second is to two coil storage cranes, roll shop, field excitation for the 38-in. and 54-in. cleaning lines, 54-in. continuous pickling line, and air compresses and coil upender for the cleaning lines. The third circuit runs to the two two-stand tin temper mills for screwdown and uncoiler motors. The fourth line runs to the tin shearing area and is a tie to the power rectifier station. This circuit includes scrap ballers, roll blast, roll storage area, field excitation for the side trimming and recoil lines, and classifier belt magnet for three tin plate shearing lines. The fifth circuit is to the annealing area cranes, of which there are two, and a tempering area crane.

The sixth circuit goes to the sheet temper mill area. Equipment in this area consists of the following: single-stand sheet-temper mill screwdowns, pack tilter, oiling machine, uncoiler shifter, leveler, entry table and delivery table; cold-reduced sheet shearing line conveyors, oiling machine and field excitation; auxiliary sheet shearing line equipment; the main drives for two downtilters, etc. The last circuit emanating from the 250-volt metal clad switch gear in the cold mill motor room leads to the five-stand cold reduction mill screwdowns.

250-volt metal-clad switch gear at the power rectifier station—The incoming line for the 250-volt switch gear at the power rectifier station is from a 1500-kw, 250-volt rectifier in the station to the incoming line breaker. Two main circuits originate at this switch gear. The first is from a 2000-amp breaker to the tinning and galvanizing gear. This consists of feeder and tinning machine drives for the hot-dip tinning unit; control for mechanical assorting lines, roller leveler and magnet rolls for the 64-in. galvanizing line; grinder and shape in the tin house machine shop; and pumps for the electrolytic line. The second circuit leaving the power rectifier station runs from a 2000-amp breaker to tin shearing, sheet galvanizing and hot-rolled sheet warehouse cranes, two tin plate warehouse cranes, and plate assorting and galvanized sheet warehouse cranes.

Some Experiences with Soaking Pits

By H. V. FLAGG, Combustion Engineer
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. . . . a frank discussion of ten years of development in soaking pit design and control . . . .

▲ SOAKING pit capacity and performance have been a serious problem at Middletown ever since the completion of the hot strip mill in 1928. Soaking pit capacity at that time consisted of six rows of four holes each, 5 ft 6 in. x 10 ft 6 in. in size, which had been adequate for the old blooming mill when rolling sheet bar. The hot strip mill introduced several new problems. Since all the tonnage was rolled into slabs, the ingots were much wider and fewer ingots could be charged into the pits, which reduced capacity. The strip mill was laid out to roll hot slabs from the slabbing mill directly through the strip mill with just a nominal reheating through short slab heating furnaces.

The original pits were cross-regenerative and were fired with raw producer gas. They were slow and the heating performance left much to be desired. The first change made was to change fuel from producer gas to natural gas, which speeded up heating and improved heating quality. It was then realized that part of the checker capacity could be dispensed with, so part of the gas checker space was used to lengthen the pits to 12 ft so that a larger charge of the wider slab ingots could be handled. In order to speed up heating, especially at the start of cold steel charges, blowers were installed on the incoming air saucers to force in combustion air faster than the prevailing checker draft could draw. This had a beneficial effect but the pits were inclined to blow so that it was finally necessary to enlarge stack flues in order to relieve the back-pressure. The dampers used for adjusting combustion air and draft permitted rough adjustments only, so that combustion control left much to be desired.

Considering that these pits were geared up for fast heating with a high heat value fuel, it would be expected that a certain amount of poor heating would be found. While cases of poor heating do occur, they are the exception rather than the rule and the soaking pit heaters must be given a great deal of credit for the skill and intelligence manifested in getting out quality work under such circumstances. It is generally recognized in the steel industry that a low heat value fuel is at least desirable, if not a positive necessity, in cross-regenerative soaking pits if quality heating is to be obtained. Our experience with both natural and coke oven gas has demonstrated that alert, intelligent heaters can get excellent results with these rich fuels on this type of pits.

Our hot strip mill rolls slabs directly from the slabbing mill so that there is no break in the process to take up the slack between open hearth tapping schedules and mill operation. It soon became evident that additional soaking pit capacity was needed if costly mill delays were to be avoided. The first addition was built in 1937, consisting of one row of four pits 18 ft 8 in. long by 6 ft 6 in. in width, to take six 57 in. ingots per pit. The next addition, built in 1941, also consisted of four holes but of 23 ft 6 in. in length to take a charge of eight ingots. A duplicate installation of these pits was built in 1941 and in 1946 another row of 18 ft 8 in. pits was put into operation. With this last addition we now have soaking pit holding capacity of 208 slab ingots as compared to the original capacity in the cross-regenerative pits of 96 ingots.

Choice of the type of pit to be adopted for enlargement of our soaking pit facilities was made only after a great deal of study. Our mill layout was such that expansion was definitely limited in all directions, and the required increase in capacity had to be fitted into the space available. This consideration was the determining factor in the final choice of the type of pit to be used. The one-way fired pit with its rectangular dimensions made it possible to build more capacity into the available space than could be obtained with any other of the modern types of pits.

Another factor that was taken into consideration in the choice of pits was that of adaptability to automatic control. It was evident that the quality of soaking pit heating was a matter of paramount importance. Since our slab heating furnaces can do little but replace the heat lost through the slabbing mill and on the transfer tables, it is hopeless to expect to make up any deficien-

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cies of heating there, and the soaking pits must do their job right if uniformly good product is to be made on the hot strip mill. At that time no satisfactory control applications had been worked out for cross-regenerative pits and none of the many expedients we had tried ourselves had shown much promise. It seemed to us that the single-burner pit should lend itself well to working out a satisfactory control. Our subsequent experience has proven this to be true, as will be discussed subsequently.

The fuel situation has had considerable influence on our soaking pit program. Our first row of one-way fired pits was equipped for natural gas only, since at that time we were assured of a plentiful supply of that fuel. After the first winter we found it necessary to add fuel oil equipment, as our supply of natural gas was restricted several times during cold weather. Several expensive attempts were made to apply fuel oil on the cross-regenerative pits, but with no success. All additions to pit capacity made since that time have been designed to burn fuel oil with provision made for either natural or coke oven gas. For the last three years all of the new pits have been fired with fuel oil while the old pits are fired with either natural or coke oven gas.

The fuel oil situation at the present time, both as regards price and available supply, coupled with the fact that in the near future we expect to have considerably more coke gas available, probably will lead us to operate all of our soaking pits on coke oven gas. We have found that our one-way fired pits operate well on either fuel oil, natural gas or coke oven gas, although the concensus is that better heat distribution in the pit is obtained from fuel oil, due probably to the long flame characteristics of that fuel.

Provision of sufficient soaking pit capacity to take up the slack between open hearth tapping schedules and strip mill operation has had a definite influence on over-all fuel consumption. Charges ready for rolling often may be held for considerable lengths of time at rolling temperature before the mill is ready for them. Also, pits may be held empty at times waiting for a heat expected from the open hearth. Such conditions require fuel beyond the amount actually needed for soaking ingots out to rolling temperature. The influence of this reserve of soaking pit capacity on mill production, on the other hand, is reflected by the fact that, at the present time, with a total charge capacity of 208 ingots, we are rolling 11,000 tons more per month from our hot strip mill than we did in the year 1944 when we had pit capacity for 152 ingots. While this increase cannot be credited entirely to the increased soaking pit capacity, it is safe to say that the increase could not have been accomplished without it.

The increase in fuel consumption consequent to the increased soaking pit capacity has not been serious, as can be shown by average over-all fuel consumptions, due to the fact that the fuel consumption on the new pits has been consistently better than that obtained from the old pits. Over-all fuel on present operation with a charge capacity of 208 ingots is 1.275 million Btu per net ton, including warm-up, holding and operating fuel. Average fuel for the year 1946, with 184 ingots charge capacity, was 1.227 million Btu. In the year 1944, with a charge capacity of 152 ingots, the average fuel was 1.118 million Btu. All three fuels, fuel oil, natural gas and coke oven gas, are included, and the heating values respectively are 142,000 Btu per gal of oil, 950 Btu per 1000 cu ft of natural gas, and 490 Btu per 1000 cu ft of coke oven gas. Representative figures for the new pits show 1.135 million Btu per net ton with 32 per cent cold steel, and .995 million Btu with 25 per cent cold steel. These figures are actual production figures collected over a substantial length of time, and include a certain amount of holding fuel as discussed above.

The history of the control applications on the successive installations of new pits makes an interesting story and is the real reason for the preparation of this paper. Back in the middle thirties we visited several existing installations of one-way fired pits and found serious objections in each one. Some of these plants had refractory tile recuperators and some had metallic recuperators, but none was equipped with any measure of automatic control equipment. Metallic recuperators had given endless trouble and in one case were being discarded. We found refractory recuperators with passes in the hot end almost entirely slagged shut. Heating performance was none too good, as we found burnt tops and uneven heating from end to end of the pits.

Our observations led us to the conclusion that all of the difficulties found could be eliminated by the application of adequate controls which should make it possible for the soaking pit heater to avoid such destructive conditions. Considerable thought and study was given, therefore to the control installation on our first row of one-way fired pits, which was built in 1937. This first row was built for natural gas only, since at that time no thought was given to the possibility that natural gas supplies might fail. The control installation included temperature control by regulation of fuel supply, fuel-air ratio control, main stack damper control for regulation of draft in the main flue, and preheat air temperature control. Individual pit dampers were provided for individual pit shut-off, actuated by hand-wheels located at the panel board. Shut-off valves were provided on the gas lines serving each pit, and were operated by hand-wheels at the panel board which had to be shut off by hand every time the pit cover was opened. The air preheat control, which consisted of a cold air leak into the hot air leaving the recuperator regulated by a temperature controller, was installed as a safety precaution against excessive temperatures in the hot air blower. This controller was set for 750 F but never functioned, since the air preheat temperature never reached that point. Air preheat on this installation fluctuated from 300 F to 650 F, with the result that neither the temperature control nor the fuel-air ratio control had a chance to function properly. The temperature control was designed to be fully modulating but never functioned properly, with the result that operation was practically off-and-on. Fluctuation of air preheat (which was bound to affect fuel-air ratio) and the lack of individual pit pressure control probably contributed to the failure of the temperature control to modulate the fuel input to the demand for heat.

After the pit had been in operation a short time, the need for individual pit pressure control was realized, and dampers were installed on each pit, arranged to be

operated automatically in response to fuel loading. This installation of dampers started a succession of difficulties which has continued up to the present time. After a year or so of operation, considerations of fuel price and uncertainty of natural gas supply led us to add a fuel oil installation which was never entirely satisfactory and gave us endless trouble. With all its shortcomings this installation gave us much superior heating over that obtained from our old pits and pointed the way, we thought, to a second installation which we felt sure would solve all of our troubles.

The second row of pits was made longer in order to take a charge of eight 57 in. ingots, and the main fuel was to be fuel oil, although a natural gas installation was included. The recuperator construction was changed from refractory tile to a double carborundum tube design. Individual pit dampers of improved design were provided. Since we had had so much trouble with the control installation on the first row, we switched to a different make of control for this second row. From the very start of operation of the second row, we found ourselves in trouble which, after considerable study and argument was determined to be due to insufficient draft. The furnace manufacturers evidently had not made sufficient allowance in designing the stack for the increase in fuel requirement for the larger pits with the result that it was impossible to maintain sufficient header flue draft to pull the pits at a time when all four pits were heavily charged. In an effort to remedy this shortcoming, 35 ft were added to the height of the stack. Air preheat temperatures on the second installation were somewhat higher than on the first, but have never been maintained at a level to insure good fuel-air ratio control. This, we believe, is chargeable to the draft limitation. Damper maintenance on this row has been better than that experienced on the first row, but there is still room for improvement. This row had a tendency to blow, especially when freshly charged, which caused undue punishment to cover seals and structures, as well as waste of fuel.

The fuel oil metering device employed in the first fuel oil-air control installation was the differential across an orifice, which was balanced against the differential across an orifice in the combustion air supply duct to maintain the proper ratio. The difficulty with this set-up arose from the fact that the hot fuel oil came in direct contact with the regulator diaphragm and no diaphragm material was available which would stand up under these conditions of temperature and pressure. Failure of the control practically put the pit out of commission until repaired, and such failures had a habit of occurring at the most inopportune times.

The second installation was built around an oil displacement meter provided with a fly-ball governor attached to the meter shaft which actuated a pilot valve to send an impulse to the ratio regulator to balance the air supply to the fuel demand. This device worked for about a year, after which the meter impellors had worn to a point where almost enough oil to run the pit would pass through the meter without any movement of the pilot valve. This naturally meant that we had no control. After struggling with this condition until our patience was exhausted, our staff rigged up an auxiliary supply of 16 oz air with an air damper connected to the fuel oil regulating valve in such manner that a change in fuel oil would send air to the natural gas-air regulator to change the combustion air supply. This device enabled us to operate, although the mechanical hook-up did not hold the fuel-air ratio close enough throughout the range to be entirely satisfactory.

Both of the control systems discussed above were actuated by a hydraulic oil system, and various troubles developed with each. Leakage could not be prevented, and after starting, was difficult to stop. In spite of scrupulous care in keeping lines clean during installation and in spite of close watch of strainers, solids accumulated in the oil systems which caused numerous control failures. Several fires occurred around panel boards or at accumulations of drippings, one of which was quite serious since an entire panel board was destroyed and had to be replaced. Several times we have been forced to drain out entire systems, clean them carefully, and provide a new supply of oil. As a result of these experiences, when we came to make plans for the third installation, we cast about for some means of getting away from the troubles we had with hydraulic oil control. After discussing the hazards of cold weather freeze-ups from condensate from the air, of dirt in the air fouling up the control, and of lack of power to move heavy dampers, and in spite of some anticipated troubles, we committed ourselves to the air-operated control.

After our experiences with the first two installations, we had arrived at a conclusion that soaking pits, due to the batch nature of the operation, would benefit from the use of forced draft. We had found that the recuperative pits had a decided tendency to blow after being freshly charged, and particularly so when the charge was cold steel. We finally realized that the cause was a shortage of draft, and reasoned that the colder flue gases had the double effect of reducing the stack temperature and at the same time increasing the mass of the gases to be withdrawn. Such a condition was particularly objectionable, since at that stage a maximum of heat release could be used and was desirable, but all that could be done was to let the pit smoke and wait until the gases had warmed up to a point where the stack would pull the load.

Accordingly, when the specifications for the third new row of pits were being worked out, we asked that an ejector stack be substituted for the conventional brick-lined stack. The decision to make this change was not arrived at without a great deal of argument and discussion. Although the first costs of the two types of stack were comparable, it was argued that the power load inherent in the ejector stack was too heavy an expense to be saddled on the pits for their entire life. It was also argued that all the draft necessary could be developed by an atmospheric stack, provided it was made tall enough. The answer to both these arguments was that, if the stack gases were not hot enough, no reasonable stack height would be adequate and that, if a nominal power charge was all that was required to provide adequate draft at all stages of operation, we could not afford not to take advantage of it. The fact that our open hearth had operated on ejector stacks for years and had made acceptable productions and costs in spite of the burden of this ever-present power cost finally swung the decision to the side of the ejector stack, and this type of stack was provided on the third installation.

Since the base fuel for the third installation was to be fuel oil, the question of the fuel oil controlling device came up for discussion and study. The orifice measuring and controlling device had been redesigned and improved since the first installation so as to eliminate the hot oil problem, so this means of control was chosen for the new installation. A gas control for coke oven gas also was included with the fuel oil control.

The furnace design proper had not been materially changed in the first two installations. On the third job some minor changes were made. The cover shoe castings were made lighter and the method of assembly was changed in order that more effective seals could be maintained. Sandstone walls were adopted after satisfactory performance had been established on some of the old pits. The power line coil reels were mounted directly on the cover, which eliminated a source of trouble that had been a nuisance on the first installation. Burner ports were made slightly larger. The gas burner assembly was not changed, but a nozzle-mix oil burner assembly was adopted which was supposed to operate without clogging. It was hoped that with this burner we would be able to switch from gas to oil, or back again, without having to change burners. In passing, we might say that we have never been able to keep an oil burner in continuous operation on soaking pits without making use of the expedient of a steam purge through the burner which is on all of the time, whether oil is on or not. We have found that we can switch from oil to gas for short periods without removing the oil burners, but if the gas stays on for more than a few hours without purge steam, the oil burners will plug up.

The third installation, our No. 9 row, was placed in operation in February, 1945, so that we have now had considerable experience with it. This was the second row of 23 ft 6 in. pits built to take a charge of eight 57 in. ingots. Some of the design details in this row require special mention. Header draft control was accomplished by means of a louvre damper mounted on the inlet of the ejector blower and actuated by an air-operated cylinder operated from the draft controller. Since the ejector manufacturer had provided an excess of capacity for safety's sake, it was soon found that the draft control was ineffective when the fuel rate was low on all four pits at the same time, and it was found necessary to provide a damper in the ejector shell below the jet, hooked up to the air cylinder in such manner that, as the louvre closed, the auxiliary damper opened to admit cold air into the stream of flue gases, thus increasing the stack load. Although we have not felt the need of this excess stack capacity up to this time, it gives us a comfortable feeling to know that it is there. Air preheat temperature control is accomplished by a damper in the preheated air duct between the recuperator and the hot air fan, which admits cold air into the preheated air stream to maintain a set temperature. This damper is counterweighted sufficiently so that it can be operated by a diaphragm motor valve actuated by a temperature controller. In addition to the function of controlling air preheat temperature, this control serves as protection against overheating of the hot air blower.

The combination of adequate stack and well-worked-out temperature control has given us regulated combustion air temperature, which we feel is a vital requirement for successful fuel-air ratio control. It may be argued that a fluctuation of a couple hundred degrees in air temperature will have a negligible effect on fuel consumption, and we are not disposed to quarrel on that question, but we do believe that such fluctuations have an effect on flame development which may affect distribution of heat transfer to an extent that pit performance may be seriously influenced.

The performance from No. 9 row has been very much superior to that obtained from either of the preceding installations. Heating is faster and much more even, fuel economy is better, furnace life is going to be better, and furnace maintenance less costly, and washing of ingots is entirely absent. The effect of this latter factor on bottom-making practice has been striking. Since no washed scale drops into the coke breeze bottom, no slag is formed and bottom making becomes merely a matter of raking out ashes and replenishing the coke breeze. No bottom making was done at all for several months after the row was placed in operation.

The question of individual pit pressure control merits some discussion. Experience has convinced us that control of pit pressure, or, more to the point, regulation of flue gas removal, is vital to good pit operation. We like the mechanical hook-up of the damper to the fuel regulator for this purpose because we can adjust the control to carry one pressure for full fuel load and another for light load. We find that the pits work best with a slight positive pressure when the fuel load is high, while a slight negative pressure is needed when the pits are holding and the fuel load is light. Such regulation would be almost out of the question if straight pressure control were used. We have heard of similar installations in other plants where they have dispensed with individual pit dampers because of the difficulties involved in maintaining them, and the operators feel that

Soaking pit heating, long dependent entirely upon the heater's skill, is improved materially by correct pit design and control.

they are getting satisfactory results without them. We have been forced to this expedient at times because of damper failure at a time when no spares were available, but have found in each case that we have lost control of our heating. Our own experience with dampers has been trying, as we have experimented with a variety of damper assemblies without yet having found one that was fully satisfactory. We have tried dry refractories which have disintegrated or have fallen off the hangers. We have used a straight steel box damper with water cooling and have had them burn up within three months. The best damper we have found up to this time is made by welding expanded metal on double U-turn cooling pipes, welding a stainless bearing strip around the tubes and ramming high-grade plastic refractory over the expanded metal. A recent announcement of a damper built up with high-temperature insulation brick tiles shaped to fit a double U-turn cooling pipe arrangement looks interesting. When the operating conditions are studied and we realize that live flames at temperatures above 2400 F and at fairly high velocities are involved, it is not hard to understand why this damper problem has been so difficult to solve.

Our experience with carborundum recuperators deserves mention. The first installation was on No. 8 row, which was the first long row and which had always been cursed with insufficient draft. This recuperator was built without access openings, so that inspection and maintenance was difficult. Due to this fact and to the fact that the row operated against high pressure much of the time and consequently with a smoky atmosphere, we found after about four years of operation that the tubes were so badly used up that complete replacement was necessary. Pains were taken on the recuperator design for No. 9 row to provide access openings at critical points, so that accumulations of flue dirt could be blown out periodically. The program of inspection and blowing has been carried out conscientiously, and we expect to get very much better life out of this installation.

Plans for the fourth row of new pits were were well under way when No. 9 row was started and it was found necessary to place orders for the control equipment before we had sufficient experience with the air-operated control to justify a second installation. In consequence, we felt it expedient to again switch the type of control and placed the order for new control of the oil-hydraulic type with improved fuel oil metering and control. The ejector type of stack and the carbofrax recuperator were chosen for the No. 10 row. This new row, because of space limitations, had to be located adjacent to No. 7 row, which made it necessary to relocate and completely rebuild the control piping, panel board and control-house for this row. Since the original control had never been fully satisfactory and since by this time the air operated control on No. 9 row was working very well, we took advantage of the situation to build an entirely new control for No. 7 row, patterned after the control of No. 9 row. At the same time the furnace and covers, which had taken quite a beating in eight years of almost continuous operation, were completely rebuilt. This row was started up after the rebuild in February, 1947, and the new No. 10 row was started in April of this year.

Hence at the present time we have one row of recuperative pits on atmospheric stack and hydraulic oil control, one row on ejector stack and air operated control, one row on atmospheric stack and air operated control, and one row on ejector stack and hydraulic oil control. Performance up to this time indicates a definite advantage for the ejector stack. Both control installations on the ejector stack rows are working satisfactorily, and more time still is needed to definitely establish superiority of one over the other. The air control does, of course, eliminate the oil nuisance, and so far we have had no trouble to speak of with the air. A separate air compressor was provided with the first air control installation to assure a supply of clean dry air independent of the plant air system, but the installation on No. 7 row has operated off the plant air system ever since it started up and for some time the auxiliary compressor on No. 9 row has been shut down and that control also operated from the plant air system.

This account of our trials and tribulations over a period of ten years of trying to build soaking pits that would measure up to the demands of the job is not written with any idea of being critical of the furnace manufacturers or of the control suppliers. We will realize, if we stop to think, that ten years ago there were no fully controlled soaking pits in the steel business and that there were a lot of steel mill engineers and operators who did not even appreciate the need for control. There was a widespread feeling that the soaking pit heater's judgment was requisite for good heating and that automatic control could not possibly compensate for lack of that personal touch. Our present day feeling is that the heater's skill is just as necessary as it ever was, but that properly functioning controls supply the heater with additional tools which will help him do a better job. It is probably safe to go further and say that soaking pit heaters could not measure up to the demands of the present day hot strip mill without the help of control.

In this connection another point should be emphasized which involves the question of dependability. If control is to measure up to its responsibility, it must do its appointed job day in and day out without faltering. If any element in the entire system fails to do its job properly so that the heater is given faulty or wrong performance, the control is worthless and the heater would be better off to depend on his own judgment. There have been many instances where heaters have developed such deep-seated prejudices against control on this account that they refuse to use them at all. It is perhaps significant that control panels are always provided with manual control switches. If a control set-up is properly engineered and constructed, the only need for a manual control should be for set-up or for adjustment.

Every step we have taken in the five installations discussed in this paper has been made with the hope of finally arriving at a place where the control would do its job so well that every person involved in the operation would have complete confidence in it. We feel that we have made considerable progress to this end. If this account of our experiences should supply any help to other steel plant organizations in the solution of similar problems, or should point the way to furnace manufacturers or to control any instrument makers toward improvement of their products, we shall consider the work well justified.

DISCUSSION

PRESENTED BY

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JOHN R. GREEN, Brown Instrument Company, 405 Penn Avenue, Pittsburgh, Pennsylvania

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H. V. FLAGG, Combustion Engineer, Armco Steel Corporation, Middletown, Ohio

R. A. Lambert: This paper given by Mr. Flagg has been one of the most frank and open discussions that I have ever heard relative to the vicissitudes of a combustion engineer. From the discussion, we understand that at Middletown hot strip mill furnaces receive hot slabs directly from the slabbing mill, and consequently, the pit heating must be correct. Our slab furnaces receives steel at atmospheric temperature, and we do have the opportunity to condition the slabs before reheating. However, I believe we all agree that any reheating process may aid or adversely affect steel quality, and that too little attention is presently paid to this heating phase of steel processing. Final temperature of the steel is not necessarily the only objective, but rather, how the final temperature was reached, be it in the soaking pits or reheating furnaces.

It was mentioned that the soaking pits at Armco used oil successfully when it was available, but that some difficulty was experienced with tip carbonization of the oil burners and due to consequent plugging it was necessary to leave steam purge through the burners. We have the same difficulties. However, we primarily use coke oven gas, and residual tar is used as the auxiliary fuel. This fuel gives more trouble than does oil.

I have listed a few questions:

1. What is the design of fuel oil burners employed in the soaking pits?

2. What is the approximate fuel input when you are holding the pit after soaking is completed?

3. What do you believe was the largest single factor in the improvement of the performance of No. 9 row of pits over the others which has resulted in superior performance?

4. The paper mentioned that soon after installation, it was realized that pit pressure control was very necessary in order to obtain more uniform heating and better fuel rates. Do you care to elucidate further on this statement and tell us also, since you do not control directly from pressure impulse, what variations are indicated in the pressure?

5. Also mentioned were the hazards existent with the use of oil operated controls. We concur with this, as we also have had some experiences with fires. However, to convert to air operated controls, a complete new set of controls would be necessary and the expense of converting is quite high. As an alternative, we are considering the use of a non-inflammable fluid to replace the oil, and we would appreciate any information you can give on this matter.

6. With exception of fire hazards, to what extent do you believe that air operated controls aided production or reduced bottom making?

7. If an additional installation of pits were contemplated of similar design, based on your experience to date, would you recommend individual pit dampers?

F. H. Dyke: Mr. Flagg has stated that better heat distribution is obtained when the pits are fired with fuel oil, due probably to the long flame characteristics of that fuel. In our opinion, a soaking pit, to be successful in these days of rising fuel costs, must be designed to give perfect quality heating with fuels at a low Btu content.

Mr. Flagg has raised one point which Middletown has in common with the Steubenville Works of Wheeling Steel, in that the soaking pit and slabbing mill production is regulated by the requirements of the strip mill. Due to this situation, much more pit capacity is required per ton of product than if the steel were rolled when ready and dumped in a yard. In the latter condition all one has to worry about is a delay on the primary mill, which is a relatively simple operation, and ingots can usually be brought up on schedule. However, when the regulating feature is a strip mill, pits must be designed so that steel can be held for extended periods of time at rolling temperature with no detriment to quality. Such a condition, with a properly designed and insulated pit, should not result in a high heat loss when the pit and recuperators or checkers can be really shut off.

We agree completely that individual holes require pit pressure control. In fact, we feel that each hole should be an individual furnace which cannot be affected by other holes in the block. Pits must be designed for quality heating and every possible variable must be controlled as completely as possible.

The industry is losing many of its skillful old heaters due to the passage of time, and it is more difficult to replace them with men of proven ability. Consequently, the operation should be made as nearly fool-proof as possible.

It is not surprising that Mr. Flagg has experienced so much damper maintenance. He is dampering live gases at a temperature of 2400 F or higher, and the best of water-cooled dampers will, in our opinion, give much trouble and will cause loss of quality heating. We prefer to damper a furnace after the waste gas has given up its sensible heat to recuperators or checkers. When this is done, the problem is comparatively simple.

There are various schools of thought on types of control systems, each of which has points of merit. Mr. Flagg has spoken of the danger of fire with hydraulic oil sytsems. This has been experienced in numerous cases. It is difficult to keep tight lines due to continual vibra-

tion. It is our opinion that any type of control, if at all possible, should be mounted on separate foundations so as to be as free as possible from vibrations of mills and mill cranes.

Mr. Flagg in his summary stated that a controlled pit must do its job so well that every person in the operation must have complete confidence in the results. We heartily concur with this conclusion and will go one step further. In our opinion the primary consideration in the design of pits must be quality heating. Every possible variation which would result in poor quality must be eliminated. Pits must have the confidence of the steel maker, as well as the mill man and the metallurgists. Any additional cost of installation to obtain these results will be returned many fold.

C. Cone: Speaking for furnace builders in general, I want to express our appreciation of the details covered in Mr. Flagg's paper. I can testify to the benefits we have derived from many years of cooperation with the engineering and operating staffs at Middletown. This paper is a chronicle covering about 10 years of progress in the application of precision control to soaking pit operation. It describes the steady improvement through four consecutive installations of one-way fired pits at Middletown, and gives a fair appraisal of the results of that progress.

I think that this is the time and place to point out that the achievements recorded in Mr. Flagg's paper, along with parallel achievements in other steel mill furnace designs and in the application of control equipment to furnaces, have resulted in a very large part from the close cooperation between furnace operators and combustion engineers on the one hand, and furnace designers and control manufacturers on the other.

As a matter of interest, another experiment is under way at Middletown which is intended to further reduce operating costs on the one-way fired pits. If Mr. Flagg cares to report on the progress made in that development, I am sure it will be of general interest.

Emil Vierow: I wonder whether Mr. Flagg can tell us anything concrete about what the improvement in the quality of heating has meant with respect to blooming mill and finishing mill yields.

M. J. Boho: Mr. Flagg is certainly to be commended for his clear exposition of the experiences he has had with the modern design of soaking pit. As control manufacturers, we feel highly pleased with the importance that Mr. Flagg attaches to combustion control.

It may be of interest to point out how operating experience changes our viewpoint in regard to certain items of control equipment. For example, Mr. Flagg mentions the preheated air temperature control unit. Originally this unit was installed as a safety device to protect the hot air fan. Mr. Flagg, however, spoke of it primarily as a temperature regulating device to insure constant temperature at the air measuring orifice, and secondarily as a safety device. This is because of the effect of constant temperature on flame development and accuracy of fuel-air ratio control.

Another point of interest that might be mentioned is the effect of certain transient conditions on overall results. It is general practice now in raising the cover of a pit to automatically shut off all fuels and air, and reduce the opening of the stack damper. After an ingot is withdrawn and the cover replaced, fuel is fired at whatever rate may be called for by the pit temperature device, which rate generally is maximum especially after one or two ingots are withdrawn. It is our opinion that much of the necessity for frequent bottom-making and preheater maintenance can be traced back to this single operation. High speed regulation of fuel and air rates and stack damper opening is necessary to quickly re-establish furnace conditions after the pit cover is replaced. By maintaining the proper atmosphere at all times, the character of the ingot scale remains such that there is little tendency to curl and break off the ingot. The pneumatic type control, such as installed on No. 9 row, has advantages with respect to speed, since the power cylinders can move through a full stroke in as little as 1½ to 2 seconds if necessary.

We feel that Mr. Flagg is to be highly congratulated for his paper. We also feel that other users of automatically controlled furnaces should in much the same way present a similar picture to the control and pit manufacturers, since only by such an assessment can we get a true picture of the value of a particular design or development, and also get an accurate idea as to how we should proceed in the future.

John R. Green: Mr. Flagg is certainly to be commended on his comments, which certainly did not pull any punches and presented much food for thought. One question can clear up a statement which has been attributed to Mr. Flagg. Was it at one time his feeling that a one-way fire pit was best controlled by a two-position or "on-off" firing method rather than by a modulating or throttling method? That point might be cleared up by his later experiences with more modern equipment.

In confirmation of the comments which Mr. Boho made on the desirability of providing special regulation of fuel inputs to soaking pits during and following drawing operations, experience has shown that such methods pay good dividends.

Mr. Flagg mentioned one point in connection with the desireability of maintaining a constant preheat air temperature, namely, that from the combustion standpoint. The maintenance of 200 F air temperature did not make any difference. We all ought to recognize that in any form of metered combustion control, air temperature does have a decided bearing on the values that we are attempting to maintain by automatic regulation. The actual number of pounds of oxygen which are delivered through a combustion air line at any fixed differential is dependent upon the air temperature.

Norman J. Urquhart: When injecting fuel into a soaking pit, you must take into account the action of that fuel against the walls of the pit. If you introduce more heat into one side of the ingot than the other you have trouble in rolling. How to get an atmosphere into the soaking pit so that all walls of the ingot will be at the same temperature is a problem. If we have whipped that, we have whipped a large part of the soaking pit problem.

H. V. Flagg: Mr. Lambert has asked several questions. First, as to the design of fuel oil burners used in soaking pits. We have used a half-dozen different burners off and on, and now are using a nozzle mix atomizer. The steam and oil are carried in separate ducts out to

the discharge end of the burner. We have experimented with this burner until a combination of steam and oil pressures, and steam and oil ports, was found which produced a flame that carries pretty well over the length of the pit.

Remember that on the 23 ft 6 in. pit we have 47 ft of flame travel, and it has taken a lot of experimental work to develop a flame that transfers heat evenly over the entire travel of the flame. I do not remember what the port sizes are, but the steam pressure is about 65 psi and the oil pressure is about 70 psi.

Mr. Lambert's second question concerned the approximate fuel input when holding the pit while soaking before drawing. I have never paid much attention to this fuel rate but I understand that the maximum oil rate is 85 gph, which modulates down to 10 gph when soaking.

The third question is, "What is the largest single factor in the improvement of the performance of this row of pits over the others?" I will have to be careful in answering this question for I am not sure that any one factor has had a predominant influence. I think we finally have gotten the various factors pretty well in balance so the pit does do a good job. As I have said before, and as several of the discussers have emphasized, the question of even air preheat temperature has a lot to do with the performance of pit control. The subject pit is the first we have ever had where we could maintain uniform combustion air temperature and the credit must be given to forced draft. We get much better air preheat uniformity on the forced draft pits.

The fourth question, "The effect of pit pressure control on uniform heating and what variations are indicated in pit pressure?" This question raises a point that I have not discussed thoroughly, but it ties in with the idea of heat transfer over the long flame travel. It is hard to organize a flame that will transfer heat evenly over 23 ft 6 in. of travel, so that it is necessary to adjust pit pressure as the fuel input changes in order to balance out heat transfer. What actually happens is that, when fuel is on full, heat transfer is concentrated at the far end from the burners. Then as the fuel input modulates downward, the flame shortens and heat transfer moves toward the burners until the charge is soaked out over the whole length of the pit. We find it helpful in this connection to vary the pit pressure from plus .03 in. water column on maximum fuel to minus .02 in. water column on holding fuel. This is accomplished by means of damper control actuated from the fuel flow with leverage adjustment.

Another question, "To what extent has air operated controls improved performance and reduced bottom making, as compared to oil operated controls?" Like his third question, must be answered carefully to be fair to various suppliers of equipment. I will say that on our last two rows, both the oil control installation and the air control installation are doing an excellent job. In other words, both types of control have been improved to the point where they are doing an excellent job.

Mr. Lambert's last question was, "If an additional installation of pits were contemplated of similar design, would you recommend individual pit dampers?" I think my answer to that question is obvious, since I have said that we cannot operate satisfactorily without dampers. We must either have individual pit dampers or we must find some expedient to take the place of them, because we still maintain the point that each soaking pit is a furnace all by itself, and, as such, it must be controlled independently of any other furnace. To do that, we must have control of the stack gases.

Before leaving this question, I might answer the question that Mr. Cone brought up. Experiments have been made with the idea of doing away with dampers entirely and using a steam jet to oppose the gases leaving the pit. The jets have been tried in several different locations with various quantities of steam and varying jet velocities. This device shows promise and might prove to be the expedient that we need to get the outgoing gas steam under control.

I appreciated Mr. Dyke's comments. I agree that pits must be designed so that steel can be held for extended periods of time at rolling temperature with no detriment to quality. We have to do a lot of that. We may have had the ingots ready for rolling in ten hours, but due to rolling schedules it was necessary to hold them in the pits 24 hr before they were rolled. I think we have finally worked out a pit installation which will hold steel quite well.

Concerning Mr. Dyke's remarks about the old heaters passing out, we have had the same experience. We have only one of the heaters left now who were there ten years ago, so we have lost much of the fine touch the oldtime heaters had with the rough control inherent in the old regenerative pits. Thus, it is quite necessary that we give them better tools to work with.

Each new installation that is made should benefit from past experience to the end that control performance should be improved. I wanted to bring out the point in this presentation that the developments and the improvements that have been made in control applications in these ten years have been remarkable.

Mr. Vierow raised the question: "What has been the improvement in heating with respect to quality and yield?"

We have no definite figures to answer that question, because our operation is so tied up with the six rows of old pits that it is very difficult to segregate the two operations. However, there are certain things that I can say without fear of contradiction. When we have tough stuff to work, it goes on the controlled pits without any exceptions. Stainless always goes in these pits; we would not think of putting this touchy grade in the old cross-regenerative pits. I do not think we are going to have to do very much more preaching to sell control pits and as time goes on the difference in performance is expected to become so evident that the operators themselves will do the selling.

Answering Mr. Green, I may have made a statement that I thought "off-on" control was desirable on one-way fired pits, and I think I can reconcile that statement now. At the time the statement was made, modulating control did not do the job, not because of the characteristics of the control but because of other conditions that prevented it from doing its job properly. We have learned in the meantime, without any question of a doubt, that in this type of pit modulating control is almost a necessity.

COMBUSTION CONTROL

. . . . the use of oxygen in combustion processes presents no control difficulties . . . . methods used for multi-fuel control may be applied to the proportioning of air and oxygen . . . .

By H. ZIEBOLZ, Vice President
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Chicago, Illinois

▲ BECAUSE of widespread interest in the use of oxygen for combustion in industrial processes, and particularly in steel mill practice, the question is often encountered how to control it in various ratios to combustion air. Fortunately the problem is one for which the answers are already available, as the technique to be employed is identical with that successfully used in multi-fuel applications.

To see the reason for this statement, it is best to go back to fundamentals: If a fuel is burned with air, a certain amount of Btu is released. Just as it is the custom to think of the fuel as the medium producing the heat in the process, it is also possible to say that the air produces the heat and the fuel is supporting combustion.

If, for instance, natural gas is available at 1000 Btu per cubic foot and the ratio of natural gas to air is 1:10, one can also consider that air has a Btu of approximately 100 Btu per cu ft.

If, therefore, we have one fuel and varying amounts of air and free oxygen, we can reduce our problem to that of a multiple fuel problem by assuming that one cubic foot of air = 100 Btu, and one cubic foot of oxygen = 500 Btu. If one furthermore knows that natural gas has 1000 Btu cu ft we know that one cubic foot of air + $\frac{1}{5}$ cubic feet of oxygen are needed to burn $\frac{1}{5}$ cubic feet of natural gas or 100 Btu + 500/5 Btu = 200 Btu = 1000/5 Btu. To take advantage of this relationship, it is only necessary to treat oxygen and air as two fuels and the fuel just as if it were the air of multiple-fuel problems.

BASIC SOLUTIONS FOR MULTIPLE FUEL CONTROLS

The complication of multiple-fuel control is due to the fact that, by the use of orifices, venturi tubes or pilot tubes for measuring flow rates, signals are obtained which change with the second power of the flow rates, and it is therefore wrong to add two such signals to obtain the signal of the sum of the flows. In order to be able to get a signal which is representative of the sum of two flows, it is therefore necessary to first produce effects which are directly proportional to the flow

Figure 1 — Summarization of air requirements of two fuels by means of controlled proportional pilot flows.

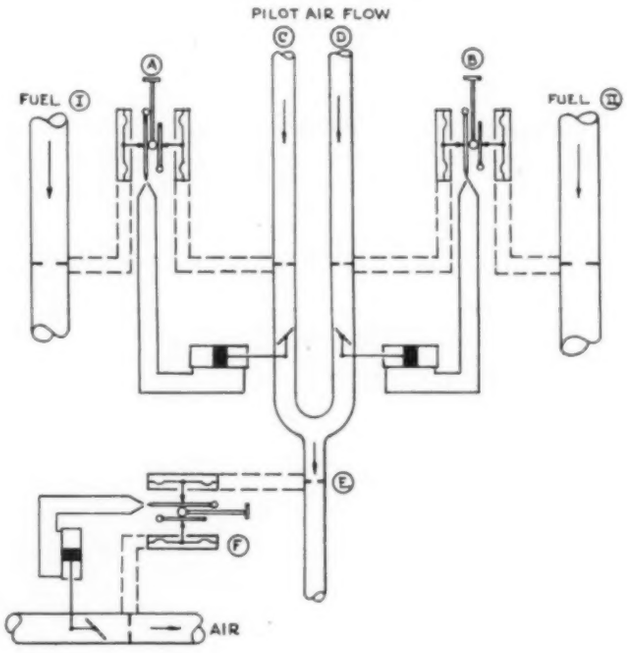
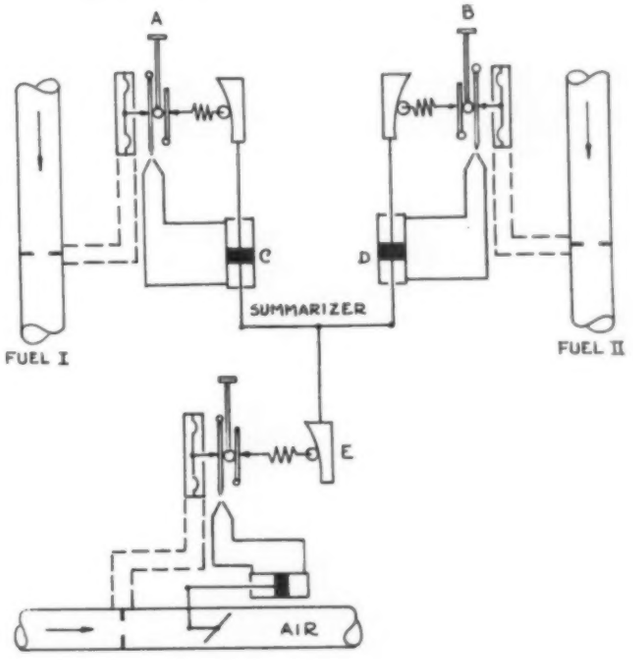


Figure 2 — Summarization of air requirements of two fuels by means of a mechanical summarizing device which adds the representative motions of cams.



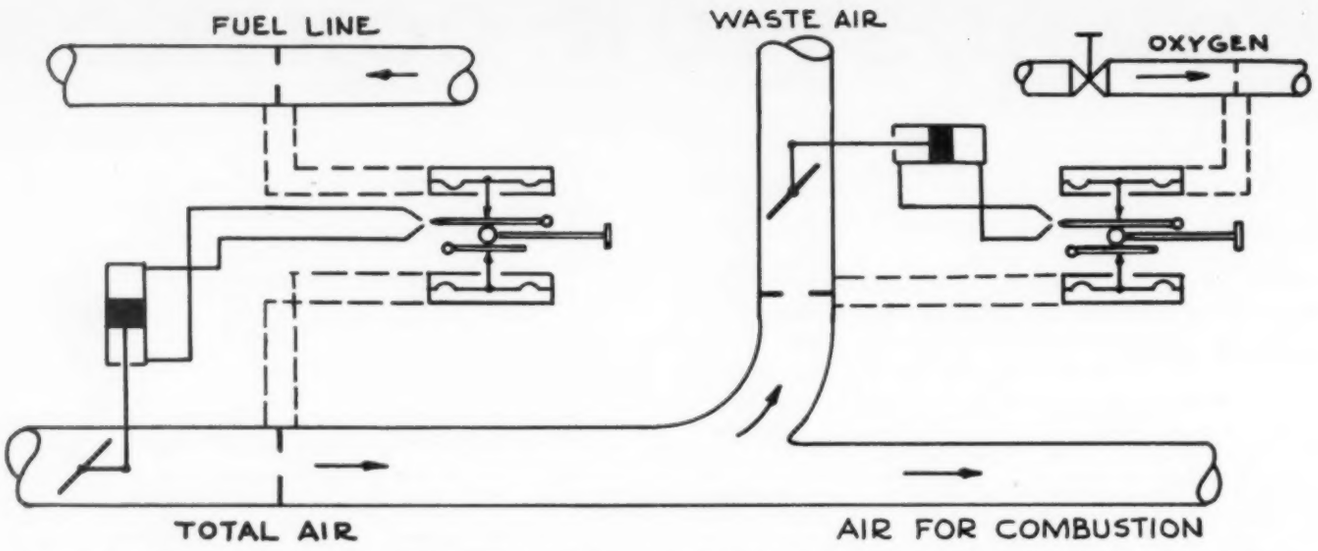


Figure 3 — Control of total air proportional to total fuel and bleeding of an amount of air directly proportional to the amount of used oxygen.

rates, and then add these two effects to obtain a signal proportional to the total.

There are two convenient methods available. The first one produces pilot flows which are directly proportional to the flow rates whose Btu rate per time unit or whose air requirements (both are directly proportional) have to be summarized. These two pilot flows are then combined and a signal is produced in the common duct which represents the sum total of both rates (see Figure 1). A ratio regulator (A) controls a pilot flow (C) proportional to the rate of fuel I. The same is done by a ratio regulator (B) controlling pilot flow (D) proportional to fuel flow II. The sum total is measured by means of a totalizing orifice (E) which indicates either total air requirement (note ratio regulator (F) which controls the air flow) or total Btu which is the same in the light of what has been discussed above.

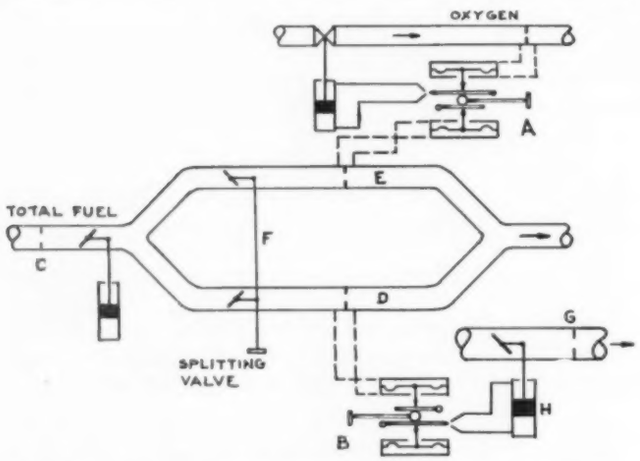


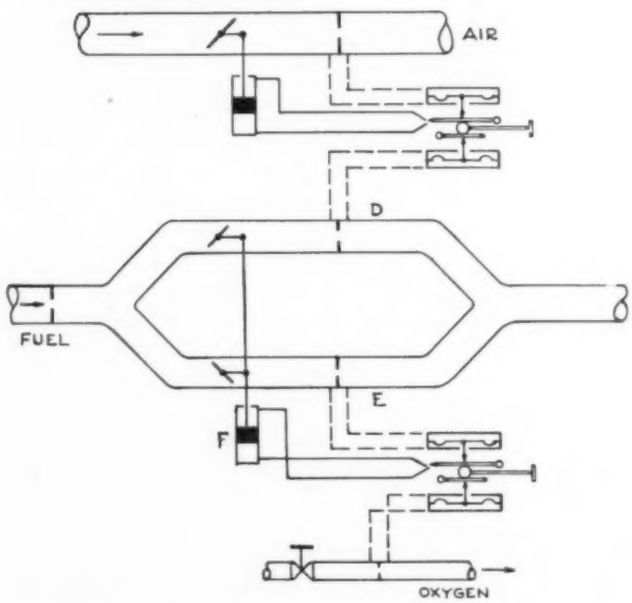
Figure 4 — Adjustment of oxygen: air ratio by splitting the total fuel supply into two branches which represent the demands for oxygen and air.

The second basic solution does not produce pilot flows, but rather strokes or motions which are directly proportional to the flow rates. These motions can be easily added by conventional mechanical summarizing devices such as differential gears or whiffle trees. It will be noted from Figure 2 that the motion of parabolic cam (C) is directly proportional to fuel rate I, and that of parabolic cam (D) directly proportional to fuel rate II. The sum total is represented by the motion of cam (E) which, again by means of a parabolic shape, produces an air flow rate directly proportional to its movements.

TYPICAL OXYGEN PROBLEM

There is practically no limitation as far as specifications are concerned and possible solutions are available

Figure 5 — Adjustment of oxygen flow by manually set valve and controlling the proportion of fuel to be burned by means of a splitting valve so that the rest of the fuel calls for air.



for any problem which may come up. But as always in technical problems it is often possible to use short cuts which simplify the necessary equipment and thus reduce its initial and maintenance cost. The purpose of this discussion is, therefore, to show some typical circuits and their application in the application of free oxygen in industrial processes.

SINGLE FUEL

A very simple short cut solution is shown in Figure 3. It is based on the consideration that oxygen replaces air for combustion. Therefore, a ratio control is first used to control the total amount of air for combustion, and a second ratio control is added to bleed an amount of air which is directly proportional to the oxygen rate used. The obvious disadvantage is the waste of air—the advantages simplicity and low cost. It is therefore a legitimate solution for intermittent or experimental installations in which power costs are a minor item.

In Figure 4 separate summarizing pilot lines are avoided by splitting the fuel line into two branches and

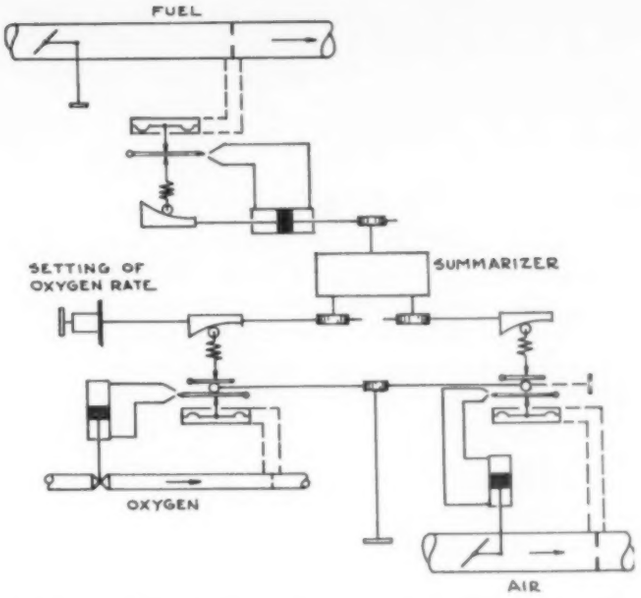


Figure 8 — Total fuel set by valve and oxygen rate controlled by regulator. Ratio of excess air (oxygen) set by means of simultaneous adjustment of air flow and oxygen flow. Mechanical summarization.

by controlling oxygen and air rates directly proportional to the rate of flows which goes through the branch orifices (E) and (D) respectively. The ratio of oxygen to air can be conveniently changed and adjusted by means of a splitting valve as shown. The obvious shortcoming of this scheme is the cost of piping of the fuel line. However, for smaller installations this cost may be more than offset by the simplicity of the circuit.

In Figure 5 the specifications call for an adjustable oxygen rate. The answer is found by controlling the splitting valve in such a way that the flow through (E) is at all times directly proportional to that of oxygen. As a result, the air flow is controlled to take care of the deficiency of oxygen. To reduce the cost of repiping a larger fuel line Figure 6 has been sketched as a possible solution. It merely bypasses the fuel across a restriction and uses the branch circuit for pilot flows.

Figure 6 — Same as in Figure 5 with a small branch of the fuel used for the pilot flows which represent air and oxygen demands.

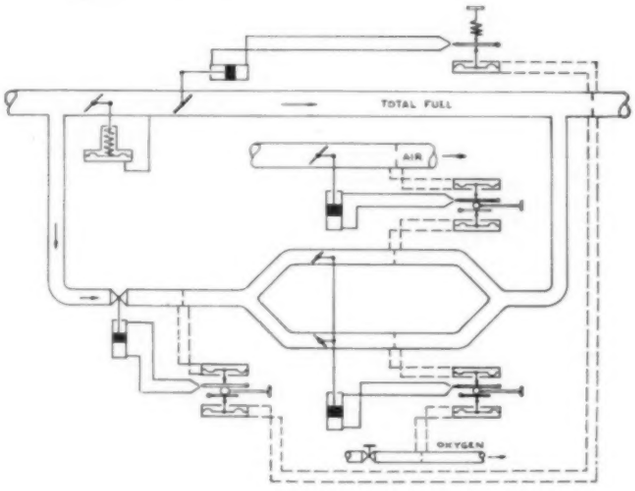


Figure 7 — Total fuel set by valve and ratio of oxygen to air set by splitting valve in pilot lines which represent air and oxygen requirements.

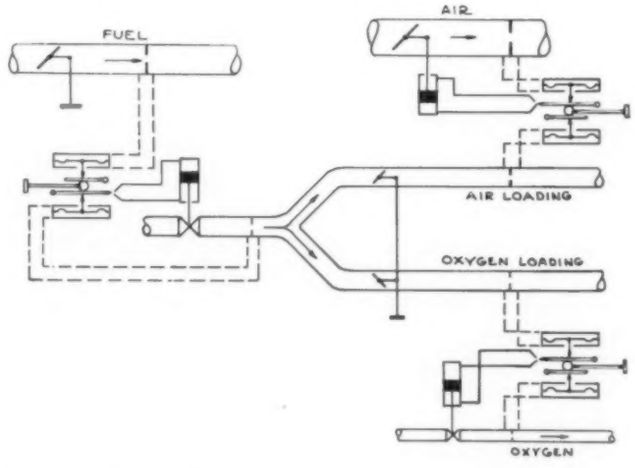
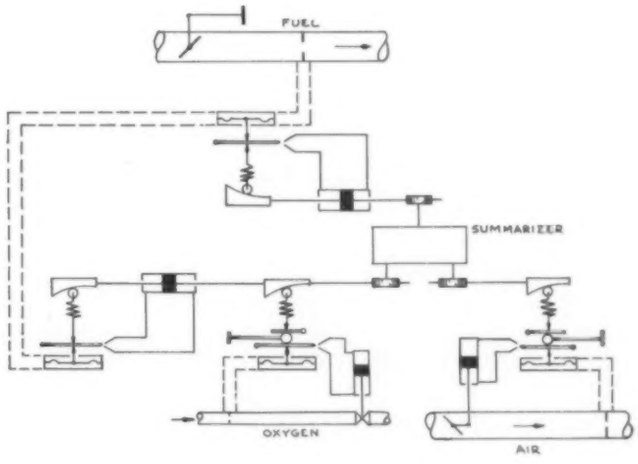


Figure 9 — Mechanical summarization. Oxygen flow is at all times directly proportional to total fuel rate.



Such a solution is only possible if the available pressure drop in the main line is great enough so that at all times sufficient flow is guaranteed through the bypass. The example is shown to illustrate that a full knowledge of all operating conditions often opens possibilities of simplifications to the control engineer. These often result in considerable savings to the user.

In line with the discussion of Figure 1, another plan has been sketched (Figure 7) which uses a source of air to produce two pilot flows. Basically, however, the circuit is identical with that of Figure 4 with the exception of the use of additional air for the pilot circuit.

In Figure 8 the rate of flow of the fuel is measured by means of a pressure drop signal which is obtained from an orifice plate in the fuel line. This pressure drop varies with the second power of the flow rate. By applying it to a diaphragm which is opposed by a spring, and by controlling the spring pressure by means of a parabolic cam which is moved by a piston in a cylinder, we obtain a stroke or motion of a cam which is directly proportional to the fuel flow. This motion is introduced into a summarizing device (a differential gear) whose other two shafts present oxygen rate and air rates of flow.

In the schematic diagram it is assumed that the desired oxygen rate is adjusted by hand through motion of a cam whose stroke is directly proportional to the desired rate. A controller which is actuated by this parabolic cam controls the rate of oxygen flow in the usual manner. The difference of the required oxygen is then obtained as a motion of the third shaft of the differential gear, and this motion in turn is used to control, through a cam, the setting of the controller which regulates the flow rate of air. By adjusting both ratio sliders simultaneously, various ratios of total oxygen and air can be obtained.

In Figure 9 the ratio of fuel to oxygen is controlled and thus also, indirectly, the ratio of air to oxygen and the ratio of oxygen to air. This is accomplished by applying the flow rate signal which represents the fuel rate not only to a regulator which introduces a motion proportional to the fuel flow into the summarizing device, but also into a regulator which controls the setting of an oxygen flow controller.

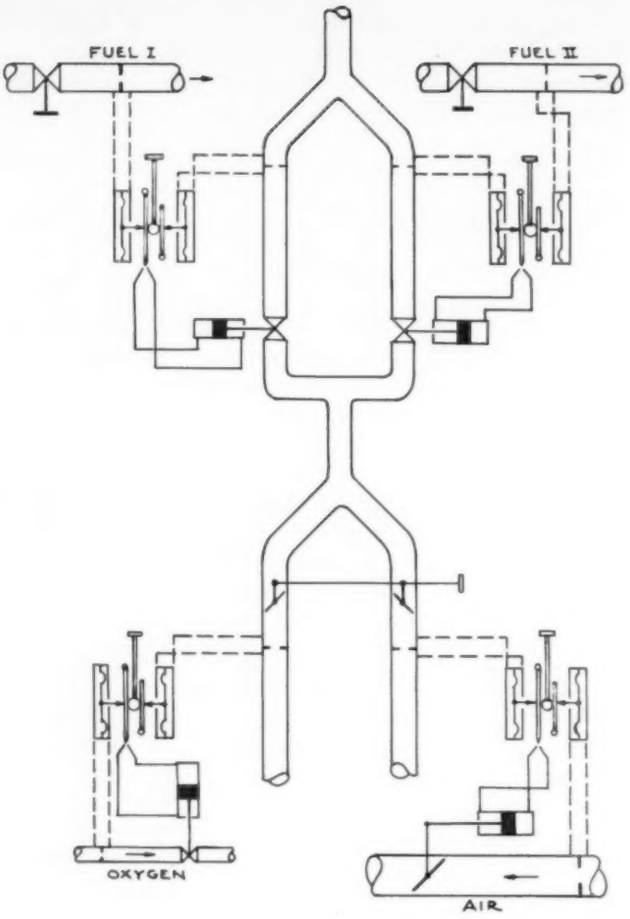
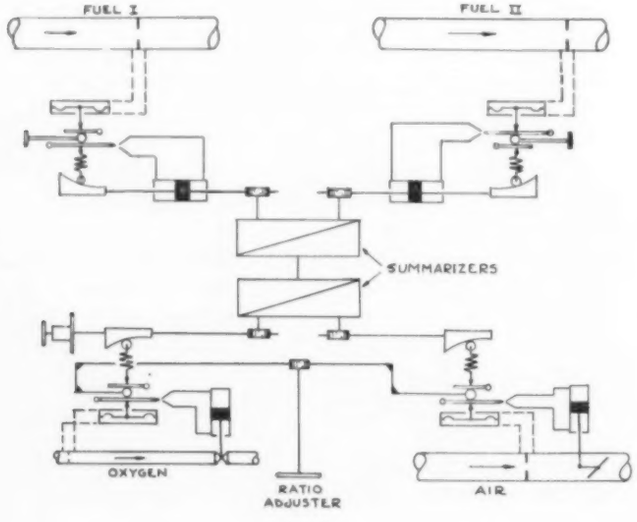


Figure 11 — Same as Figure 10, but pilot flows are used for summarization. Splitting valve adjusts ratio of oxygen to air.

The deficiency of oxygen is controlled by the output of the summarizing gear which controls the flow of air. The reason for making it possible to eliminate this controller is that the motion obtained from the fuel rate is directly proportional to the one to be fed into the second shaft of the summarizer. By inserting a variable linkage (multiplier) different ratios of fuel to oxygen can be conveniently set.

Figure 10 — Individual fuels vary independently. Air requirements are mechanically summarized. Total oxygen adjusted and controlled. Deficiency of air controlled.



MULTIPLE FUELS

If more than one fuel is used, the input shaft for the summarizer just mentioned is controlled by the output shaft of the summarizer which gives the sum total of both fuel rates (Figure 10). Assuming a constant oxygen rate, the second shaft of the second differential is adjusted to a value which simultaneously establishes the setting for the oxygen flow controller. The difference or deficiency of oxygen is again represented by the motion of the third summarizer shaft, and the ratio of total fuel to total air is adjusted by a simultaneous setting of the ratio sliders of both the oxygen and the air controller.

The same problem of two fuels with variable ratios

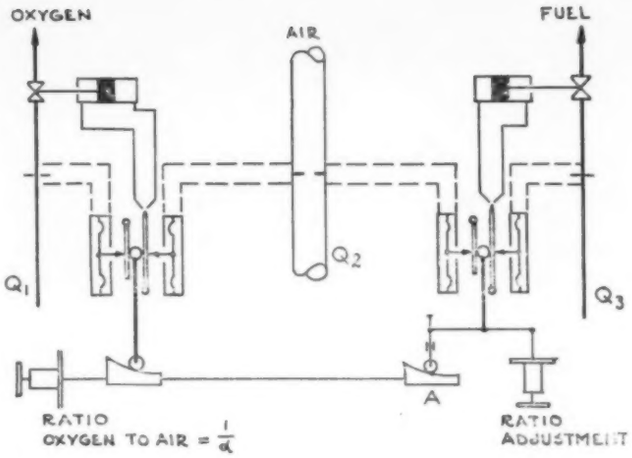


Figure 12 — Control of oxygen to air ratio and total oxygen to fuel, within limits given by the regulator design.

of oxygen and air is solved by means of pilot flow circuits as shown in Figure 11. The first step is to produce pilot flows directly proportional to the rates of flow of fuel I and fuel II. The next step is to split the total fuel into two branches which are used to produce respective signals for the oxygen and air flow regulators. This diagram can obviously be varied to take care of fixed oxygen supply rates, in which case the solution would be similar to the one shown in Figure 5 where the splitting valve is controlled by a regulator responding to the oxygen rate of flow.

SPECIAL CIRCUITS

In Figure 12 a circuit is shown which permits, within certain limits inherent in the regulator design, to adjust varying ratios of oxygen and air, and a variable ratio of total oxygen and fuel.

By controlling the ratio of oxygen rate to air rate by means of the left hand ratio regulator, we also establish the necessary correction factor for the right hand fuel regulator which takes its signal from the air flow only. This correction factor is introduced simultaneously with the adjustment of the air: oxygen ratio by means of a cam whose stroke is added to that of the ratio adjuster of the total oxygen fuel regulator.

The fact that a mechanical summarization by means of a whiffle tree is permissible in spite of the fact that the correction factor calls for multiplication is due to the peculiar ratio slider characteristic which approximates very closely a logarithmic fraction. If a multiplication of factors can be accomplished by summarization of logarithmic scales, the above solution is technically sound.

The above circuits show that the use of oxygen in industrial combustion processes does not present any basic difficulties, as the methods available for multi-fuel control can be directly applied to this problem. Close co-operation between the plant engineer and the control engineer is very desirable at an early stage of such projects, as great simplications and corresponding savings can frequently be obtained by compromising only slightly with regard to specifications.

SPECTROSCOPE USED TO IDENTIFY STAINLESS STEEL GRADES

▲ RAPID differentiation between various grades and detection of residual elements in stainless steels at the Wood Works of Carnegie-Illinois Steel Corporation are now effected by spectroscopic methods. This plant has found the procedure valuable for making rapid and accurate qualitative determinations, especially in identifying stainless steel grades which owe their identity to one or more modifying elements.

The photograph illustrates the test for small percentages of aluminum with the spectrographic method. The top and middle spectra show faint but unmistakable lines for aluminum at the wave lengths indicated, and are representative of 12 per cent Cr-Type 405 (0.10 to 0.30 per cent Al). The bottom spectrum is representative of 12 per cent Cr-Type 410 (0.05 per cent Al max). Note that even the stronger line (3961.54 A^0) has not recorded. Photographic methods are necessary for this test as the wave length of the aluminum radiation is shorter than 4000 A^0 and is therefore invisible to the human eye.

One of the useful applications of the instrument is to confirm the grade of hot-rolled plates as received at the mill before any further processing. This avoids costly processing of the wrong grade to sheet product. All orders for stabilized grades are checked for the presence of the proper stabilizing element, and all orders for Type 405 twelve per cent chromium steel are checked for the presence of aluminum before shipping.

Some contaminating elements picked up by steel in service may be quickly detected.

Chromium may be easily detected in the percentages used in stainless steels, but quantitative estimates are not feasible. It is possible to distinguish a 4-6 per cent chromium steel from 12, 17 and 27 per cent chromium steels, but the latter three cannot be infallibly separated.

Nickel may be visually detected when present in amounts common to stainless steels (7 to 12 per cent nickel). No effort has been made to determine low nickel contents common to the straight chromium grades.

Lubricants for Cold Rolling Steel

By R. J. NEKERVIS and R. M. EVANS
Battelle Memorial Institute
Columbus, Ohio

. . . . a progress report of an investigation seeking a substitute for palm oil in the cold reduction of strip steel . . . .

▲ AN investigation leading to the development of a mineral-base rolling lubricant to replace palm oil in the cold reduction of steel to tin-plate gages was undertaken in late 1943 as a research project sponsored by the Shell Oil Company. At that time, the future supply of palm oil was extremely uncertain. A satisfactory substitute was the immediate goal of this investigation. The final objective was a superior replacement. This latter phase of the investigation has not been completed.

A review of the literature and considerable exploratory work on possible substitutes indicated that a fundamental approach was necessary. The ensuing program was essentially a study of the various chemical factors involved and their effect on rolling lubricant performance. In this program, the effects of the following factors were considered:

1. Chain length and configuration of saturated and unsaturated hydrocarbons from petroleum. The effects of combinations of the various promising constituents from petroleum with the other materials of the type listed below were investigated.
2. Fatty acids. The effects of degree of saturation, chain length, and configuration were studied. Common available acids were first studied, and in an ensuing investigation, acids of the type necessary to substantiate any indicated trends were synthesized.
3. Esters, glycerides, and soaps. Besides studying the effects of these materials neat, their effects in combination with fatty acids were considered.
4. Alcohols, alone, and in combination with other factors.
5. Petroleum additives. Film strength, detergent, antiwear, and oiliness agents were considered. Additives to promote lustre, and surface-active agents to increase the adherence of the lubricant to the sheet under high-pressure water sprays were also in this group.

Results obtained in the study of the chemical factors are beyond the scope of this paper. They are mentioned here only to illustrate the chemical bases upon which lubricant selections were made. While the physical requirements of lubricants and methods of evaluating them may have been of only auxiliary importance in obtaining suitable lubricants for tandem mill rolling, the effectiveness of the methods used was the most important item in making selections, and also in affording an explanation of the reasons for palm oil's satisfactory performance. The degree of success in selecting a satisfactory replacement is of chief importance and is the subject of the next several sections. Lubricant requirements are first considered, and then the attainment of these requirements in commercial practice.

Presented before AISE Annual Convention, Pittsburgh, Pennsylvania, September 22, 1947

LUBRICANT REQUIREMENTS

In considering the various requirements of a lubricant, the reduction in external friction was obviously the most important. However, there seemed to be a possibility of reaching a degree of friction reduction past the point where slipping of the rolls would occur. This factor seemed to require that methods of evaluation simulate actual commercial rolling conditions as closely as possible. Other requirements closely related to friction reduction were stability, ease and uniformity of spreading, and adherence of the lubricant to the sheet.

Stability might be defined as unimpaired friction-reducing properties after continued service. What is wanted is a lubricant which will be in a reusable condition after gravity separation of water and coarse particles, followed by centrifuging to remove the finer particles of dirt.

In evaluating the other related factors, ease and uniformity of spreading and adherence of the lubricant to the sheet, the effects of high-pressure water sprays were of prime consideration. Two other important factors not related to friction reduction are ease of removal after rolling and the attainment of satisfactory lustre.

While adhesion of the lubricant to the sheet is an important property during rolling, it becomes a deleterious one immediately afterward. The ideal situation would be one in which the cleaning step would be eliminated altogether. Complete removal of the lubricant by vaporization was, therefore, a major objective and should this not prove feasible, satisfactory cleaning in existing equipment was next in importance.

The attainment of lustre was important for two reasons. Besides the obvious enhancement in value through eye appeal, the investigation showed that with some lubricants lack of lustre was a manifestation of surface tearing of the sheet.

The selection of the lubricant was based upon the result of evaluation methods for these requirements. These methods approximated commercial rolling conditions as closely as possible. Other important requirements, such as toxicity and costs, were considered, but did not require any special testing methods.

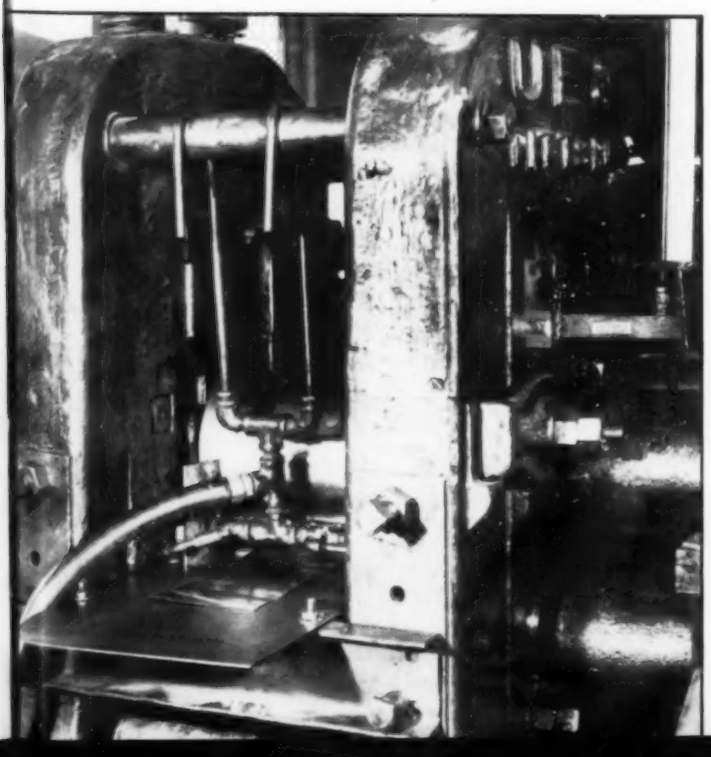
EVALUATION OF LUBRICATING PROPERTIES

The method of evaluating lubricating properties was essentially a measurement of the friction coefficient on a laboratory cold rolling mill with all rolling variables except reduction in thickness and pressure, either held constant, or varied at equal rates and amounts.

The laboratory mill and auxiliary apparatus used for making these measurements are illustrated in Figure 1. Only a portion of the mill is shown to better illustrate the water spraying and pressure-measuring devices. The mill is a two-high combination hot and cold mill with forged steel, 8-in. diameter x 12-in. rolls mounted in plain bronze bearings. The mill is driven by a 50 hp motor. Pressures were measured by means of a capsule-type pressure gage especially constructed for this work. It was placed between the bearing and the screwdown on one of the housing posts, as illustrated in Figure 1. Essentially, it is a Hadfield steel spring, the strain resulting from compression within the elastic limit being indicated by a mercury column. Calibrations were made at regular intervals on a Baldwin Southwark universal testing machine.

A cooling water-spray apparatus having a line pressure of 70 psi was constructed to deliver jets which were directed into the roll nips on the entry side from both below and above the center line of the nips, and also on the top and bottom of the entering sheet. The sprays were set up to wash the lubricant off the entering sheets.

Figure 1 — Laboratory rolling mill set up for testing lubricants on thin steel sheet. Note the pressure measuring device just above the top roll neck.



In obtaining a simple and reliable method of comparing the friction-reducing properties of lubricants, the expression derived by Stone and Greenberger [1]* from Nadai's [2] equation of the condition for equilibrium of the horizontal forces deforming any small column of material seemed to fit our needs best. The coefficient of friction in this equation was exponential:

$$P_{avg.} = \frac{S_o e^{\frac{\mu L}{T}} - 1}{\frac{\mu L}{T}} \qquad (1)$$

where:

μ = friction coefficient.

L = contact length, in.

$P_{avg.}$ = average pressure (psi) exerted on the contact area and equal to the total rolling pressure in lb ÷ L × the sheet width in inches.

S_o = constrained yield strength of the material being rolled and equal to 1.155 × normal yield strength.[2]

T = draft or average of entry and exit thickness in inches.

Because the deformation resistance tends to increase with decreasing thickness owing to the skin effect, a relatively thin standard entry thickness (0.0100-0.0110 in.) was chosen. This, in turn, necessitated taking roll flattening into account because the roll flattening effect tends to become greater with decreasing sheet thickness. Trinks' and Hitchcock's [3] approximate equation for finding the length of the deformed arc of contact was used to determine the degree of roll flattening:

$$L = \sqrt{R(T_1 - T_2) + \frac{16\,PR(1-\sigma)^2}{\pi WE}}$$

where:

L = contact length of the same value as L in equation 1.

R = radius of the rolls, in.

T_1 = entering strip thickness, in.

T_2 = delivered strip thickness, in.

P = total rolling pressure, lb.

σ = Poisson's ratio, assumed to be 0.30 for forged steel rolls.

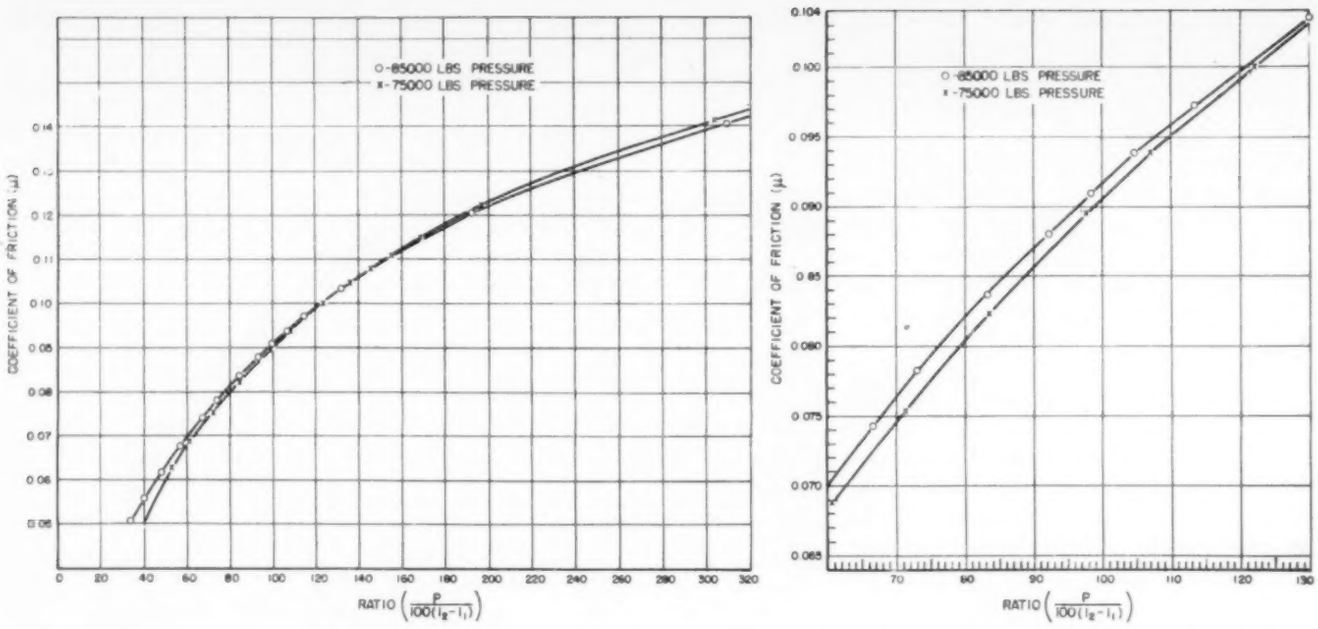
W = width of strip, in.

E = modulus of elasticity, assumed to be 29.5×10^6 for forged steel rolls.

In using these equations as a basis for predicting performance on a tandem mill, consideration of the assumptions made in deriving these equations indicated that the following could be safely accepted.

1. That the coefficient of external friction between the sheet and rolls is constant.
2. That plain vertical sections of the sheet before rolling remain plain during rolling.
3. That lateral spread does not occur, and also that the criterion for yielding, S_0, is 1.155 times the normal yield strength and holds for the material rolled and conditions of rolling.

* Numbers refer to bibliograhy at end of this paper.



Figures 2 and 3 — Curves showing the relationship between coefficient of friction and the ratio $P \div 100\ (l_2 - l_1)$ for screw pressures of 75,000 and 85,000 lb. Figure 3 on the right is an enlarged section of Figure 2.

Other assumptions made were that effects of front and back tension and the effects of the great increases in speed and specific pressure met with in actual tandem mill practice would not be appreciably different with different lubricants. In other words, it was assumed that the lubricant rating positions would be unchanged. Treatment of the assumption of no work-hardening is dealt with in a later section of this paper.

METHOD OF TESTING FOR ROLLING PERFORMANCE

The method of making comparisons of lubricant performance finally adopted as a result of check tests in commercial practice was to roll uniformly precoiled rimmed steel sheets of uniform grade, temper, hardness and dimensions at constant speed and roll temperature in a single pass with the screwdowns set at a uniform idling pressure with and without high-pressure cooling water spraying on the sheet and rolls.

As a result of investigational work on the effect of variations in the rolling test conditions, the steel selected as standard for these comparisons as rimmed, type L, T-4 temper, fully deoxidized, 5 x 25-in. sheets, cut from the center sections of coils. The thickness was between 0.0102-0.0104 in. for most of the test runs. Roll speed, temperature, and idling pressures selected as arbitrary standards were 120 fpm, 140 F. and 50,000 lb, respectively. Line pressure of the cooling water sprays was 70 psi.

Precoiling corresponded to 6 lb per ton (based on a 90 lb basis weight) and was resorted to only after tandem mill rolling tests showed that the dripper lubrication (i.e., dripping the oil on the sheet as in actual practice) prevented accurate comparisons of lubricants. There were, then, actually two standard comparison methods used: those in which the dripper method of lubrication was used, referred to as the standard dripper method, and those using precoiled sheet, referred to as the modified standard method. Except for the method of applying the lubricant, both are the same. Reasons for precoiling with a measured amount of lubricant are discussed in another section of this paper.

Differences in thicknesses before and after rolling were obtained from the sheet extension, using the formula:

$$T_1 - T_2 = T_1\left(\frac{\text{Final length} - \text{Original length}}{\text{Final length}}\right)$$

The coefficient of friction could then be obtained either by substituting this value and the total screwdown pressure, which was read directly from the gage, in the equations given or, more simply, from a curve relating the friction coefficient to the ratio, $P \div 100\ (l_2 - l_1)$; that is, the total pressure in pounds over 100 times the extension in inches. By relating two factors having opposing effects in this fashion, the effects of variation in pressure were minimized. The relationship between this ratio and calculated friction coefficients for total pressures of 75,000 and 85,000 lb is shown in Figures 2 and 3. Figure 3 is a section of Figure 2 in the range of relative friction coefficient values where, presumably, satisfactory performance on a tandem mill is achieved. These curves illustrate the effectiveness of using the ratio given above to minimize the effect of variation in pressure.

In using this method, it is very important to keep the thickness and hardness of the sheets for any comparative test in as narrow a range as possible.

EFFECT OF WORK HARDENING ON LUBRICANT RATINGS

Although it would have been better, from the standpoint of eliminating the effects of work hardening alto-

gether, to use full-hard sheets as test specimens, the extensions obtained in a single pass on the laboratory mill set at the highest pressures possible yielded a spread of values too narrow for accurate comparisons. The resistance to deformation in this case was so large in relation to external friction that accurate comparisons of lubricant were impossible. Tests run on full-hard plate using the standard testing method with dripper lubrication and calculating the friction coefficient by substitution indicated qualitatively that the relative lubricant ratings were not appreciably affected by reducing the hardness of the test plate. Continuing the investigation to obtain more accurate comparisons, the standard dripper test method (without cooling water sprays) was followed using both T-4 temper and full-hard plate as before, but using five passes on the full-hard plate instead of one. Because five passes were used on the full-hard plate, arbitrary ratio values described previously which bore a direct relationship to the friction coefficient (see Figures 2 and 3) were used in the place of friction coefficients. Typical values obtained using this method are given in Table I. Values on both hard and soft plate for the various lubricants bear the same relation to each other. On the basis of results such as these, it seemed reasonable to expect that increasing the hardness of the test sheets would not alter the relative ratings appreciably. Included in Table I are values obtained with water spraying on the rolls. These show that the effect of water is of more consequence on the relative lubricity ratings than is the effect of increasing hardness. It was expected that the spread between the lubricant ratios would be narrower with full-hard plate owing to the effect of work hardening being greater with the better lubricants. However, the test cited along with other tests covering a wider range of friction coefficients do not show appreciable differences. More complete confirmation on the effect of work hardening on the lubricant ratings will be available after the results of an investigation in progress have been verified in actual practice.

EFFECTIVENESS OF THE METHOD OF EVALUATING PERFORMANCE

The effectiveness of predicting lubricant performance in a tandem mill from the results of laboratory test methods can be covered best by examples selected to show the reasoning back of the selection and pointing out the causes for discrepancies between lubricant performance on the laboratory and tandem mills.

In the early work in this investigation, the spread in lubricant properties between palm oil and other lubricants ("doped" and "undoped" mineral oils of widely varying viscosities, for example) was so large that unpromising constituents could be quickly weeded out. The wide spread between the friction coefficients of mineral oils, with and without additives, and palm oil is illustrated in the figures given below:

Lubricants	Co-efficient of friction	Ratio $\frac{P}{100(l_2-l_1)}$
Nigerian palm oil (15% F.F.A.)	.091	100
Mineral oil 1, viscosity 2500, SUS at 100 F	.120	185
Mineral oil 2, viscosity 900, SUS at 100 F	.115	165
Mineral oil 3, viscosity 100, SUS at 100 F	.115	165
Mineral oils plus additives (up to 5 per cent)	.105-.119	135-180

These tests were run by the standard dripper method using cooling water sprays.

In carrying out the program to determine the effect of the various chemical factors on rolling performance, lubricant constituents having friction coefficients falling throughout the whole range between mineral oil and palm oil were found. In addition, a number of constituents were found which had appreciably greater friction-reducing properties than did palm oil. This provided a selection of constituents which would meet any desired friction coefficient, either above or below that of palm oil. Because of the danger of roll slippage, however, a lubricant was compounded which showed exactly the same friction-reducing properties as palm oil, and met other requirements fairly well. This test was run in the same manner as the standard dripper test described. Tests were run with and without 70 psi line pressure water sprays. Power consumption figures obtained in commercial practice on the lubricant selected on this basis showed that mill loads were 25 per cent higher than palm oil when both were used at the rate of 8 lbs per ton and 15 per cent higher when the amount of the experimental oil was raised to 13 lb per ton. Moreover, an obvious drawback, high volatility of

TABLE I

Comparison of Lubricating Properties of Various Lubricants

Type of steel and rolling conditions	Lubricant				
	226	220	214	Palm oil	222
	Ratio(1)	Ratio	Ratio	Ratio	Ratio
T-4, type L sheet without cooling water	81	83	87	89	96
T-4, type L sheet with cooling water	102	96	102	100	111
Full hard, type L sheet, actual measured ratio without cooling water	191	191	198	200	213
Full hard, type L sheet, corrected ratio value from line 3 above(2)	85	85	88	89	95

(1) Evaluation given is the ratio Total pressure (lb) ÷ 100 × extension (in.). See Figures 2 and 3 for relationship of ratio to coefficient of friction.
(2) These ratios are obtained by multiplying ratios given in line 3 by the factor: Ratio of palm oil for T-4 temper plate from line 1 ÷ ratio of palm oil for hard plate from line 3. This is done so that the values obtained for T-4 temper and for full-hard temper may be compared on the same basis, i.e., line 1 with line 4.

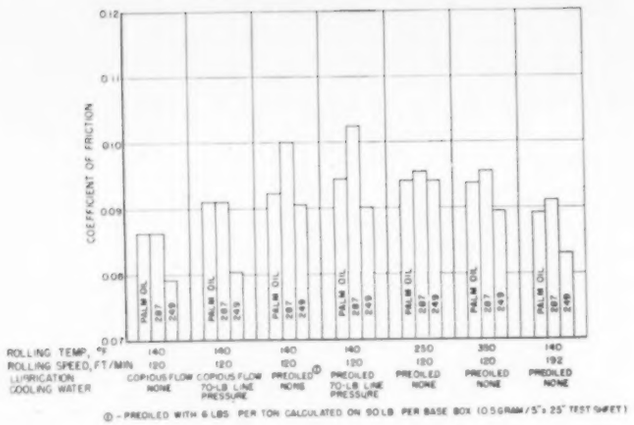


Figure 4 — Effect of changes in quantity of lubricant, rolling speed, and temperature on rolling ratio.

one of the constituents had been overlooked. To find the reason for this discrepancy, the effect of variations in roll speed and temperature and amount of lubricant was rechecked. The effect of cooling water was also taken into consideration. Figure 4 illustrates graphically the effect of variations in these conditions on the lubricity ratings of palm oil compared with the experimental lubricant No. 287, which was tested commercially and also with a third lubricant No. 249, which was chosen because it had greater friction-reducing properties than did palm oil.

The most important finding brought out in Figure 4 from the standpoint of accurately predicting performance on a tandem mill, is that a difference in the quantity of lubricant used markedly affects the lubricity ratings. A comparison of the first group of three bar graphs with the third group of three, and also the second group with the fourth group in Figure 4 will effectively illustrate this. When rolling without water, using dipper lubrication (with the result that several times the highest amount used in commercial practice was applied), the friction coefficients of palm oil and the experimental lubricant 287 are equal (see first group of three bar graphs, Figure 4). With cooling water using the same method of lubricant application, their friction coefficients are slightly higher but again are equal. However, using preoiled (6 lb per ton) sheets, keeping other conditions the same, there is a wide difference between the friction coefficients of palm oil and the experimental lubricant 287, the former being much lower in these cases (group III and IV, Figure 4). The differences in coefficient of friction between palm oil and the other lubricant, No. 249, are much less with preoiled sheet than with the dripper lubricated sheet (group I, II, III, and IV, Figure 4). Although lubricant No. 249 is still appreciably lower than palm oil in the preoiled sheet tests. Raising the roll temperature did not affect the ratings, except that when one of the constituents in oil No. 287 evaporated away, the friction coefficient was reduced (see groups V and VI, Figure 4). The effect of a 50 per cent increase in speed is shown in group VII, Figure 4. Comparing group VII with group III, there is an apparent reduction in friction coefficient with all lubricants. The relative rating positions, however, have not changed much.

These examples illustrate the type of tests being used as a basis for lubricant selection. Besides the tests outlined, the attachment of the lubricant to the sheet is being measured by spraying a fine mist of the lubricant through high-pressure water sprays and determining the friction coefficients under standard conditions using palm oil as a standard.

This phase of the investigation has not been completed. The effect of slight variations in hardness are also being accurately determined in connection with this phase of the investigation.

EVALUATION OF CLEANING PROPERTIES

In usual commercial cleaning practices, hot alkaline cleaners are preferred for removing fatty materials. Petroleum-base materials, on the other hand, are usually best removed by solvent cleaning. Although dislodging the lubricant by means of plating out hydrogen on the steel surfaces in electrolytic cleaners would be of considerable aid in removing petroleum materials, the material removed would not saponify so easily as does palm oil unless the petroleum base was modified in some manner, for example, by making detergent additions. Moreover, alkaline cleaning is now accomplished without current in at least one major plant.

The alkaline cleaners used in the industry were designed to remove palm oil. Indeed, perhaps palm oil's greatest drawback as a rolling lubricant is the fact that everytime it is used, the steel requires cleaning before annealing.[4] In selecting lubricant constituents for a replacement, therefore, materials were sought which would vaporize from the sheet without staining, thus making it possible to eliminate the cleaning step.

The apparatus used to determine whether or not a lubricant would stain upon annealing is shown in Figure 5. An attempt was made to follow plant annealing conditions as closely as feasible. The annealing cycle was to heat from room temperature to 1250 F in 30 minutes, hold at 1250 F for 20 minutes, and cool by means of an air jacket around the hot zone of the furnace to 250 F and remove. Oil pumped nitrogen with 4 per cent hydrogen to take care of traces of O_2 and H_2O in the nitrogen was used for the atmosphere.

Two methods for determining straining tendencies were used. In one, the lubricated sheets were cut up into small uniform sizes and the sheets bolted together like pages in a book. This method did not prove very selective. Even palm-oil lubricated sheet did not stain appreciably when tested in this manner. The other method was to make a ball indentation in a single sheet, using an Olsen Ductility Test Machine for this purpose. One drop of the lubricant was then placed in the indentation and the sheet placed in the annealing furnace.

Typical results obtained in this test are illustrated in Figure 6. The distillate materials, while still not so bright as the precleaned control sheet, do not have the lacquer forming characteristics or the carbonaceous deposits present in the residue materials. The reflectivity of the palm oil lubricated sheets makes palm oil appear better than was actually the case. A film of lacquer almost covered the sheet and flaky carbonaceous particles were present in the indentation. A chlorinated

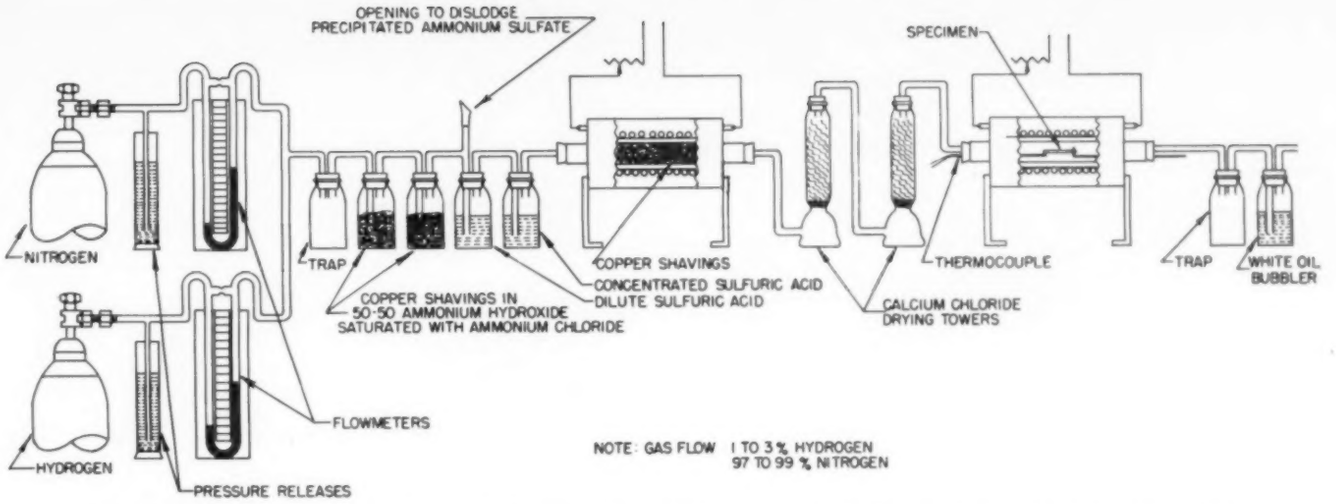


Figure 5 — Diagram of apparatus used to determine staining characteristics of lubricants upon annealing.

lubricant is included in this group to show the objectionable staining obtained with such materials. Carbonaceous deposits covered the entire panel.

As yet, commercial tests to bear out the validity of this second method have not been run. There is a possibility that the degree of cleanliness obtainable by annealing alone would not approach that of the precleaned material sufficiently to warrant omitting the cleaning step. The experimental lubricant No. 287, which was tested commercially, exhibited fairly satisfactory cleaning properties in Meeker's cleaners which were not operated electrolytically. In one of these tests, sufficient palm oil in the cleaner was present to aid saponification. In the other test, no palm oil was present. Satisfactory results were obtained in this test by using a baffle to keep the supernatant lubricant from coming into contact with the strip issuing from the cleaner.

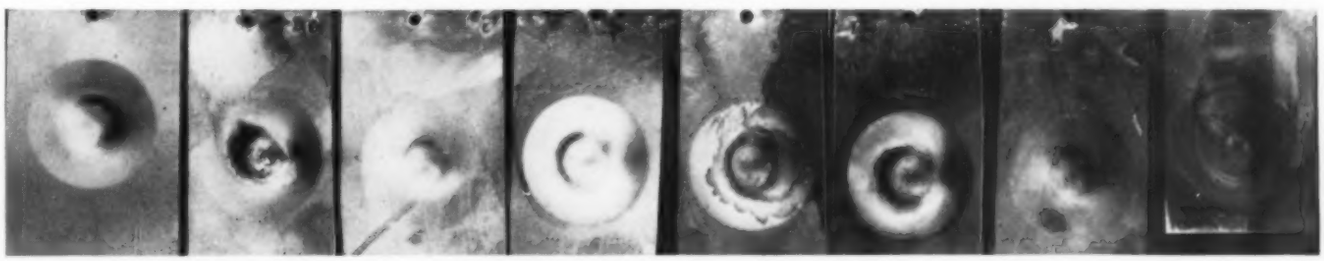
EVALUATION OF LUSTRE

The degree of lustre obtained on rolled surfaces depends to some extent on the roll material, roll finish, and on the material being rolled. The rolling lubricant also has a pronounced effect.

In evaluating lustre, two different approaches were used, one was to measure the reflectivity of the sheet in foot-candles. The apparatus used for this measurement is sketched in Figure 7. Rolled sheets lubricated with palm oil were used as a standard. These had a reflectivity rating on the range of 40-45 foot-candles. The experimental oil, No. 287, had an equivalent reflectivity rating. This range of ratings seemed to be the highest obtainable for lubricants having friction-reducing properties in the same range as palm oil. Kerosene had a reflectivity rating around 50 foot-candles. Values above 30 foot-candles had satisfactory eye appeal. Some of the lubricant constituents, promising in other respects, showed values as low as 18 foot-candles.

The other approach was to get a step further and compare the sheet surfaces under higher magnification. Surfaces to be examined were sweated on to machined copper bases and the surface examined at various magnification. A magnification of 500 times with oblique illumination was found to be quite effective in illustrating that the poor lustre obtained with some materials was a result of tearing of the sheet. This is a manifestation of the stick-slip phenomenon discussed by Bowden and Laben.[5] Photomicrographs of sheets illustrating varying degrees of tearing are shown in Figure 8. It will be noted that palm oil and the experimental oil 287 which was tested on a tandem mill show approximately the same slight degree of tearing. Lubricant No. 22, a

Figure 6 — Annealed sheet specimens showing degree of staining with different lubricants and lubricant constituents.



Control	Palm oil	Distillate No. 47 from petroleum	Distillate No. 24 from petroleum	Residue No. 22 from petroleum	Residue No. 27 from petroleum	Distillate No. 24, treated	Chlorinated compound

petroleum-base material, was selected to show the extreme tearing of the surface obtained with some lubricants. Bowden and Laben found that small additions of organic acids would reduce this effect. The reduced amount of tearing shown with Lubricant No. 22 with 10 per cent oleic acid added substantiates this.

The friction-reducing properties and the lustre-imparting properties of the lubricants analyzed did not bear any relationship to each other.

Another type of dulling is illustrated in the photomicrograph of plate rolled with the residue from the molecular distillation of palm oil. In this case, etching of the sheet rather than tearing is responsible for the dullness obtained.

STUDY OF PALM OIL

The uniqueness of palm oil as a rolling lubricant has been a subject for conjecture in the discussion of rolling lubricants with operating personnel. In addition, there has been a division in opinion on such related items as the effect of palm-oil constituents, the use of aged tinning oils for rolling, and the choice of application method. Results of an investigation of palm oil may, therefore, be of some interest.

Except for its low price in normal economic periods, palm oil is not unique in its ability to reduce friction. Cottonseed oil, castor oil, lanolin, and many others have friction-reducing properties in the same range as palm oil, some to a slightly smaller degree, some to slightly greater. Both the acid and glyceride constituents of palm oil contribute to friction reduction. The acid constituents reduce friction to a greater degree, but the hard saturated acid constituents interfere with bite and cause the rolls to slip. Slippage of the rolls was so severe with palm-oil acid lubricated sheets that reduction on the laboratory mill was almost impossible. This effect is well known and maximum palm-oil acid contents are specified by most mills. Glycerides are good lubricants in their own right, and while the degree of friction reduction is lessened with lower amounts of acid constituent, the glycerides alone would probably perform satisfactorily in the tandem mill. The following comparison between palm-oil acids and refined palm oils having varying amounts of acid constituents present illustrates the relative effects of the acid and "base oil" or glyceride constituents on friction reduction. The effects seem to be additive:

	Free fatty acid content, %	Co-efficient of friction
Acids from Nigerian palm oil (16% F.F.A. originally)	....	.085
Nigerian palm oil	16.0	.091
Refined Nigerian palm oil	0.55	.101
Refined Sumatra palm oil	0.20	.100
Re-refined Sumatra palm oil	0.02	.100

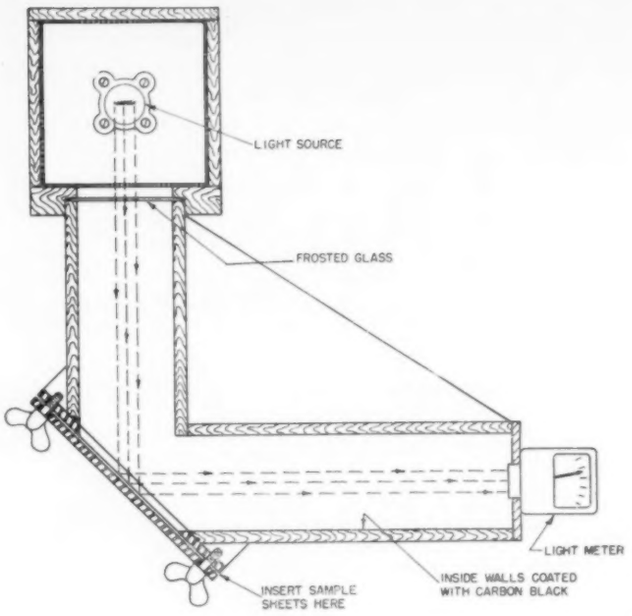


Figure 7 — General arrangement of device for measuring lustre of the cold rolled sheet.

Continuing along this line of investigation, the effect of various fractions obtained from the molecular distillation of Nigerian palm oil (16 per cent F.F.A.) were determined. Eight fractions were obtained having the acid numbers given.

Fraction number	Per cent cut	Acid No.
Original Nigerian palm oil	....	32.0
1	10.1	197.0
2	13.5	49.0
3	17.0	2.0
4	15.9	1.0
5	16.5	0.7
6	13.9	1.2
7	4.5	1.9
8	3.5	3.3
Residue	5.2 (by diff.)	7.4

Under the same conditions of testing, that is, with the standard dripper method without water cooling the rolls, the fractions showed approximately the same friction-reducing properties as palm oil. Some were very slightly less, none was greater. The residue seemed to reduce friction slightly more than did the original palm oil, a matter of a few hundredths as indicated by calculated friction coefficient values.

The effect of soaps on the friction-reducing properties of palm oil was next considered. Plans were to analyze a palm oil "solution" which had been used for some time on a tandem mill for iron soaps after determining the amount of finely divided iron present. Unfortunately, this sample has not been received as yet. The effect of tin soaps in palm oil was considered next. Tin is present in the aged palm oil from the tin pots in amounts up to about 4 per cent tin. The following results illustrate that heavy metal soaps are detrimental in the presence of cooling water sprays:

Lubricant	Cooling water sprays	Co-efficient of friction	Lustre, foot-candles
Palm oil	None	.086	42
Palm oil	70 psi line pressure	.091	41
Palm oil + tin soap(1)	None	.084	32
Palm oil + tin soap(1)	70 psi line pressure	.098	37

(1) 3 per cent tin present.

Indications are that tin soaps also exert a slight detrimental effect on the lustre. Phosphides, which might be present in palm oil as impurities, were also found to be somewhat detrimental.

Since there was some doubt concerning the relative merits of either applying palm oil and cooling water separately or applying them as a single mixture or emulsion, four "emulsions" chosen to represent those used in commercial tandem mill practice were compared with the performance of palm oil using the dual system of separately applying the lubricant and cooling water. Results shown in Table II indicate that, with the exception of "emulsion" No. 169, it makes little difference which method is used.

TABLE II

Lubricating Properties of Commercial Rolling Solutions

Lubricant number and composition	Co-efficient of friction	Lustre, foot-candles
168 — 9% palm oil, 90% water, 0.9% tall oil, 0.1% triethanalomine	.033	40
169 — 2% palm oil, 96.5% water, 1.5% V1001 soluble oil	.105	36
170 — 5% palm oil, 93% water, 2.0% V1001 soluble oil	.092	36
170A — 5% palm oil, 93% water, 2% V1001 soluble oil (1% lactic acid added)	.033	37
Palm oil, dual method, standard dripper method, 70 psi cooling water sprays	.091	40

An error may have been made in assuming that only 2 per cent palm oil was used commercially (lubricant No. 169). None of these so-called emulsions were true emulsions. However, there is reason to believe that two component mixtures may be preferred to true emulsions.

In closing, it should be pointed out again that this investigation has not been completed and that an accu-

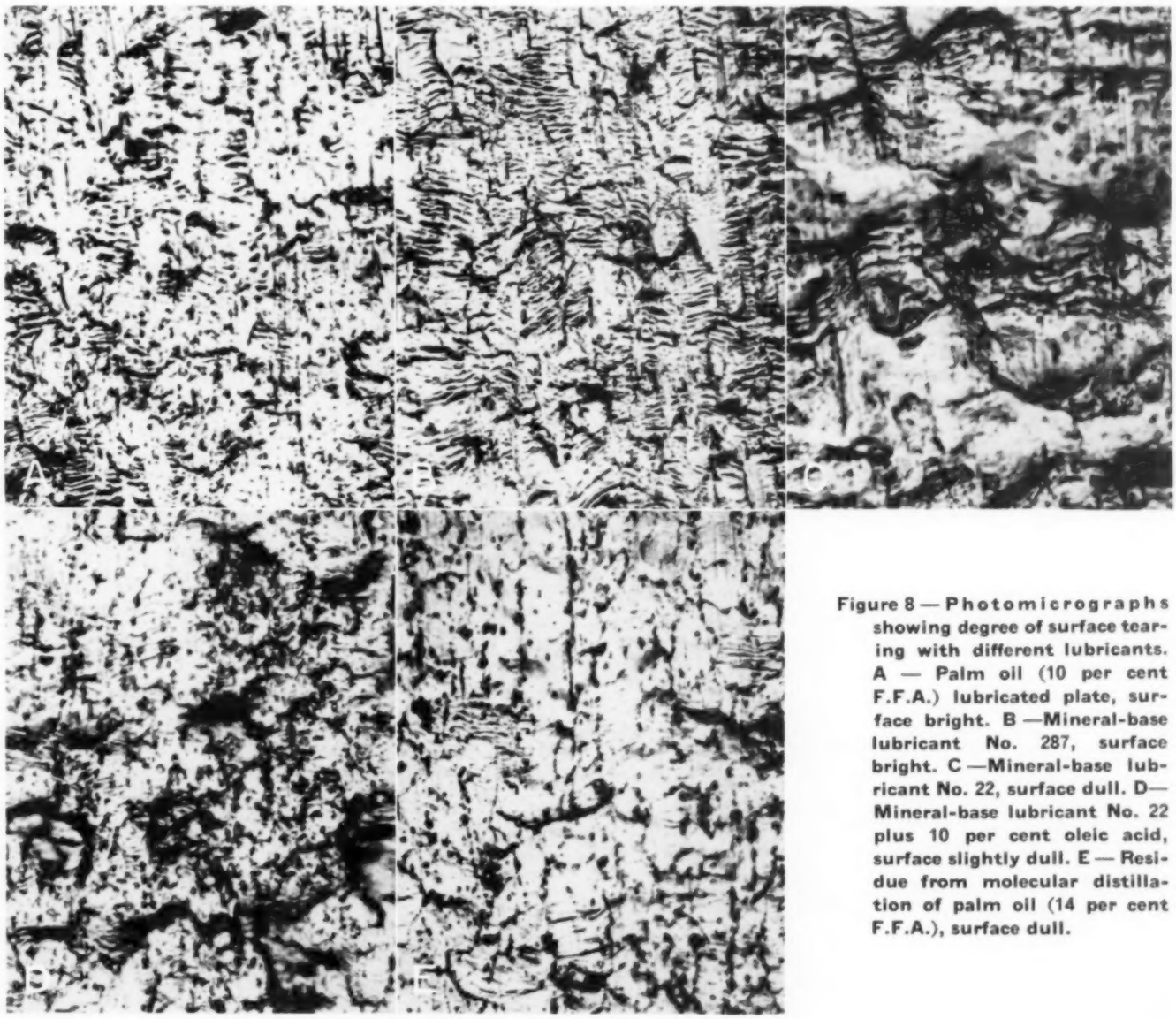


Figure 8 — Photomicrographs showing degree of surface tearing with different lubricants. A — Palm oil (10 per cent F.F.A.) lubricated plate, surface bright. B —Mineral-base lubricant No. 287, surface bright. C —Mineral-base lubricant No. 22, surface dull. D— Mineral-base lubricant No. 22 plus 10 per cent oleic acid, surface slightly dull. E — Residue from molecular distillation of palm oil (14 per cent F.F.A.), surface dull.

rate appraisal of the results obtained cannot be made until the findings have been substantiated in actual practice. Work along a similar line of investigation, the development of lubricants for aluminum impact extrusion, has qualitatively borne out the findings in this investigation.

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DISCUSSION

PRESENTED BY

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C. E. PRITCHARD, Chief Lubrication Engineer, Republic Steel Corporation, Cleveland, Ohio

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M. D. Stone: I should like to congratulate the authors of this paper in presenting a quite original method of analysis of rolling oils, which goes far to evaluate lubricants from various points of view, all of which are pertinent in the cold rolling of steel. Particularly is their choice of evaluating the frictional characteristics of their lubricants under rolling mill conditions, such as high concentrated pressures, complex sliding, etc., a good one.

The use of the relationship between rolling pressure, contact lengths in the bite, thickness of strip being reduced, and the co-efficient of friction, that we worked out some time ago, seems to have been utilized very pertinently by the authors in evaluating the frictional conditions during rolling. The authors' presentation of this relationship in Figures 2 and 3 is particularly interesting, and I believe has served them well in evaluating lubrication performance. There is a dearth of information on the frictional conditions in rolling as typified by extremely high pressures, and in lieu of such specific information. I feel the authors have done an excellent job in their manner of approach to the problem.

Their further investigations as to the variations in such conditions as a function of different types of oiling, water cooling, and the evaluation of oils from the point of view of subsequent cleaning by conventional strip cleaning methods, is also well handled. I should judge that their critical studies would go very far toward evaluating the oils as they would show up in subsequent commercial rolling operations.

It is interesting to note that they are able to demonstrate that it is possible to have too good a lubricant, which would be a point that the writer would like to hear developed in some greater detail. Co-efficients of friction based on palm oil and other superior lubricants show values no less than 0.08, yet difficulty was experienced with lubricants that were apparently better than that. These are not low co-efficients of friction as such, and any further elucidation along these lines would be of general interest.

Undoubtedly the authors are familiar with work that has been done both here and in England on the friction properties of various lubricants at high pressures, by Messrs. Boyd and Robertson of the Westinghouse Corporation, and by Drs. Orowan and Hoff of the Cavendish Laboratories. While these investigators do not agree as to the absolute values of friction co-efficients for the various lubricants, at the high pressures, they both list several lubricants whose frictional properties are better than palm oil. Among such lubricants are stearic acid, molybdenum di-sulphide, etc. It would be interesting to evaluate some of these same lubricants by the rolling method and see how the comparison works out.

R. J. Nekervis: Except for check tests in actual tandem operation, the rolling pressures used in this investigation are on the lower side of those used by Boyd and Robinson. In this range some of our findings are confirmatory; some are not. To begin with, there is general agreement on the effectiveness of fatty oils in reducing friction co-efficient at high pressure. Our co-efficient of friction values, however, are somewhat higher. Moreover, we show a wider spread between the fatty oil and mineral oil co-efficients. Mixtures of both oleic and stearic acids in various oil bases showed approximately equal friction-reducing characteristics at equal concentrations up to the point where solid particles of stearic acid were precipitated. When this occurred, "bite" was impaired to such an extent that the sheet would not pass through the rolls. This would seem to bear out Boyd's and Robinson's results showing remarkable friction-reducing properties for stearic acid.

Owing to the difficulty of removing lubricants containing dispersed solids, we included only a few of them on our investigation. Our experience would lead us to expect molybdenum sulphide to have the characteristics cited by Boyd and Robertson.

C. E. Pritchard: One point of extreme interest to me was the decided increase in co-efficient of friction with 70 psi line pressure. It answers a question that has been in my mind for some time as to just what effect a high line pressure would have on the co-efficient of friction. I sincerely hope that this type of work can be furthered to a point wherein definite conclusions can be expected

regarding the several questions covered in this paper.

C. R. Hand: This question of where the work is done on the tandem mill and what the palm oil does has been a problem a lot of us have been sleeping and working and fighting with for ten or twelve years. It is gratifying to see that somebody has built a test mill, even though it does not roll commercially. It is very pleasing to know that somebody has had the time and funds and has been given or has bought the lubricants and various materials that he has tested.

To assimilate in the laboratory exactly what occurs on a mill is impossible. The conditions that happen on one mill never happen on another, but as far as I have been able to learn, going from mill to mill, give the rollers palm oil and they will roll tin plate. Give them anything else and trouble starts.

Men like Mr. Nekervis and others who work on this problem are some time going to get us something to put on a mill that is going to do everything palm oil does without some of the objectionable things we have to put up with palm oil.

J. D. Lykins: One other property a rolling oil should have is the ability to keep the rolls clean; that is, not to have a build-up of oil and foreign matter along the edge of the strip, as this impairs rolling.

Another thing, I doubt very much that we could eliminate the cleaning of steel after rolling. Perhaps we could, from the standpoint of the rolling oil itself, but today our equipment is not 100 per cent mechanically perfect. We have leakage of oil and grease around our mills. This with other contamination getting on the strip will necessitate the washing operation.

R. J. Nekervis: Answering the second question first, the ideal thing would be elimination. I know that a good share of the dirty oil that comes from bearings gets on the steel, which has to be cleaned. I appreciate that it may be impossible to eliminate these contaminants. The practical goal in this investigation is a lubricant that will not be a source of trouble if it should be left on the sheet inadvertently.

In regard to the roll cleaning ability of lubricants, this factor was frequently called to our attention by operating personnel at the start of our investigation and was, of course, taken into account in developing replacements for palm oil.

LIQUID METAL PRACTICE*

By R. D. DWYER
Carnegie-Illinois Steel Corporation

▲ THE liquid metal process, from a quality standpoint, can produce many grades of steel that are normally produced by the basic open hearth process.

It has been found that liquid metal steel is actually preferable for some applications than basic open hearth steel in attaining certain mechanical properties. An outstanding example is in the lower carbon steels for tin-plate application, particularly low-phosphorus grades with high temper requirements, and aluminum killed grades that will be subjected to fluting hazards during forming. In the case of aluminum killed tin plate heats, it has been found that the microstructure of finished sheet product from liquid metal heats is just as satisfactory for severe forming as that obtained with basic steel of similar grade. On rimmed and mechanically capped steels over 0.12 per cent carbon or 0.60 per cent manganese the vigorous rimming action obtained in liquid metal steel results in appreciably better surface quality than is obtained with basic steel of these compositions.

In addition to sheet and strip products, large tonnages of structural plate and shapes, as well as bar and semi-finished material are made by the liquid metal process. A large portion of our die-rolled crankshaft production is currently being produced in this shop and its performance has been highly satisfactory. Fine-grain forging quality steels are being successfully produced in considerable volume.

The limiting factors in the use of blown metal processes are primarily economic.

*Condensation of paper presented before AIME, Pittsburgh, Pa., April 12-14.

BASIC FURNACES AND ENDS*

By M. F. YAROTSKY
Carnegie-Illinois Steel Corporation

▲ THE South Works' all-basic furnace was started up on the 6th of June, 1947. The operation of this furnace has been carried out as a series of cycles of heats, the cycles being varied as to firing rate and medium employed to obtain high furnace and flame temperatures, with data being assembled and recorded 24 hours a day. The furnace was operated continually until November 5, 1947, when it was taken out of production for a period of five days for refractory repairs.

The next two repairs were made at 472 and 529 heats, requiring fuel-off periods of 10 and 24 hours, respectively. Total amount of brick used in all roof patches was equivalent to approximately 80 per cent of the original main roof. No further repairs to the furnace are anticipated in the current campaign which will end late in March or early in April at approximately 650 heats.

From the thorough inspection of the furnace refractories during the repairs, the following important facts were brought to light:

In contrast to previous experience elsewhere with basic end construction, the port ends and uptake areas were marked by very rapid erosion and slag accumulations, were somewhat fused and not as granular or as easily removable as has been reported for other installations. This is believed to have resulted from the very high firing rates practiced on the furnace with the high temperatures and gas velocities involved.

The roof construction, with minor modifications, shows considerable promise of being able to withstand a full campaign of 400 or more heats without patching. It will be necessary to modify the end construction, as well as firing methods, to bring about balanced erosion of the port ends and roof.

*Condensation of paper presented before AIME, Pittsburgh, Pa., April 12-14.

THE QUANTITATIVE DUST

. . . . with the constant pressure for smoke prevention and dust control, this discussion of the various methods of determining dust in gas is of particular interest . . . .

▲ PRECISE dust determinations are the result of careful and ingenious application of known technical principles to prevailing conditions. Dust may be of any size, dryness or water solubility, depending on its source. Dust may be the product of grinding or erosion, such as coke dust in blast-furnace and coke-oven gas, producer gas and sintering plant flue gases, or it may be sublimated or eroded oxides of potassium, sodium, magnesium and calcium, or sublimated metallic oxides and silicates found generally in steel plant furnace flue gases. Sublimated carbon (soot) or tarry residues will be found in the gases resulting from partial or incomplete combustion of raw fuels, such as coal, petroleum, ligneous by-products, unsaturated hydrocarbon and synthetic gases.

The size of such dust may therefore vary from amorphous or microcrystalline aerosols of alkaline and metallic oxides, less than 10 microns, to the larger crystal agglomerates or fragments of coal, coke, iron ore or ash of 150 microns or 100 mesh screen equivalent, or even larger, depending on the source and the conditions of formation.

Most furnace gases are saturated with water at their prevailing conditions of temperature and pressure. If these gases have been passed through a wet washer or scrubber, they may carry some entrained moisture as "carry-over" from the scrubber, but this condition will prevail only in the immediate vicinity of the scrubber outlet.

The continual accumulation of line moisture is the result of the decrease in the temperature of gas leaving the scrubber and could be remedied by using water of lower temperature in the scrubber, by increasing the contact efficiency or by decreasing the velocity through the scrubber. This condition of precipitated moisture also prevails in the equipment used in sampling and dust determination. It is therefore necessary that any equipment of this type be corrected or modified to eliminate moisture precipitation where objectionable.

The fundamental objective in the gravimetric determination of the dust content of a gas is the quantitative separation and collection of the dust from a measured volume of gas in a container which will permit accurate weighing. The three important steps in securing a dust sample are:

1. Sampling
2. Metering of the gas volume sampled.
3. Separation and collection of the dust.

An intelligent understanding of the requirements and technique of accurate sampling is the first step in making a dust determination. Let us first define the sampling tube as a metallic or non-metallic tube which is used to divert a sample of dust-laden gas from its regular path to the dust-separating element. The gas-sampling tube should be as short as possible in order to eliminate errors due to the adherence of dust to the inner wall of the tube. It should have a nozzle with a sharp edge which must be pointed directly into the gas flow during the sampling period, and during the test the same rate of flow must be maintained through the nozzle as through the main. The following precaution is quoted from page 130, "Methods of the Chemists of the United States Steel Corporation for the Sampling and Analysis of Gases": "In sampling the gas, it is necessary to withdraw the sample without changing its velocity, as to do so will change the dust content on account of the greater inertia of the solid particles. Messrs. Brady and Touzalin, ("Journal of Industrial and Engineering Chemistry," September 1911), have shown that, when the velocity of the gas in the sample pipe is half the velocity in the main, the results are over forty-four per cent too high."

The size of the sample nozzle depends on three factors:

1. The size of the gas main being sampled.
2. The rate of flow in the gas main. This point must be determined either by metering or from pitot tube traverse and calculations.
3. The assumed rate of flow in the sampling-tube nozzle, which must not be beyond the capacity of the test meter's capacity.

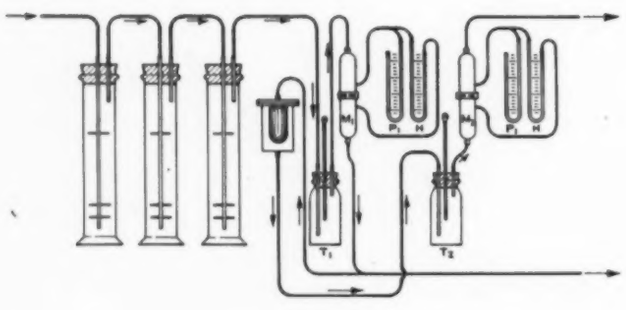
With these factors known, it is now possible to calculate the rate of sampling and the diameter of the sampling nozzle from the following formula:

Let Rm = rate of flow in gas main, in cfm.
Rs = rate of flow in sample nozzle, in cfm.
Dm = diameter of main, in inches.
Ds = diameter of sample nozzle, in inches.

$$\text{Then } \frac{Rm}{Rs} = \left(\frac{Dm}{Ds}\right)^2 \qquad (1)$$

$$\text{And } D = \sqrt{\frac{RsDm^2}{Rm}} \qquad (2)$$

Figure 1 — General arrangement of wet scrubbing and filtration apparatus.



DETERMINATION OF

IN GAS

By A. H. ARBOGAST, Combustion Engineer
Bethlehem Steel Company
Bethlehem, Pennsylvania

With the actual diameter of the sample nozzle (Ds) determined, the rate of sampling through this nozzle will be found by transposing the above formula to:

$$Rs = Rm \div \left(\frac{Dm}{Ds}\right)^2 \qquad (3)$$

Inasmuch as a pitot tube traverse will show that the flow of gas in a cross-sectional area will vary according to the pipe contours, pulsation, etc., it is generally necessary to establish, by means of the pitot tube, a section of average flows in which the sample nozzle will be immersed for sampling.

The use of these pitot readings provide an accurate means for calculating the rate of sampling; and in field work, with the dimensions of the gas main, sample nozzle and revolutions per cubic foot of meter known, this formula can be reduced to one unknown, the velocity head (P) determined by the pitot tube. For example:

r = revolutions of gas meter per cu ft = 4
Dm = diameter of gas main = 42 inches
A = area of gas main = 9.64 sq ft
Ds = diameter of sample nozzle = 0.25 inches
Wa = weight per cu ft of blast furnace gas = 0.0733 lb
V = feet per minute $= 1096.2\sqrt{\frac{P}{Wa}}$

P = velocity head in inches of water
S = seconds per revolution at calculated test speed
Then $\frac{60}{r}$ = seconds per revolution of meter at rate of 1 cfm.

$$S = \frac{60}{r} \div Rs$$

Solving:
$$Rs = \frac{Rm}{\left(\frac{Dm}{Ds}\right)^2} = \frac{1096\sqrt{\frac{P}{Wa \times A}}}{\left(\frac{Dm}{Ds}\right)^2}$$

$$Rs = \frac{1096.2\sqrt{\frac{1}{.0733}} \times P \times 9.64}{\left(\frac{42}{0.25}\right)^2}$$

$$Rs = 1.37\sqrt{P} \qquad (4)$$

$$S = \frac{60}{r} \div Rs = 15 \div 1.37\sqrt{P} = \frac{10.9}{\sqrt{P}} \qquad (5)$$

The meter correction for temperature and pressure will vary inversely as the general gas law for the reason that an increase in the rate of flow means a decrease in the seconds per revolution of the meter, and vice versa. For example:

Temperature of main	= 100 F
Temperature of meter	= 80 F
Pressure of main	= 0.5 in. of mercury
Pressure of meter	= —3.0 in. of mercury
Barometric pressure	= 30.0 in. of mercury

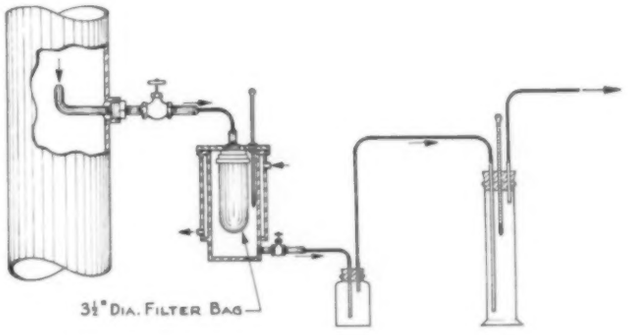
Then, letting S_1 = calculated seconds per revolution corrected to temperature and pressure, we have:

$$S_1 = \frac{S \times 560 \times 27.0}{540 \times 30.5} \qquad (6)$$

The calculation of Wa or weight of 1 cu ft of blast furnace gas at test conditions proceeds as follows:

	Volume, per cent	Cu ft per cu ft		Lb per cu ft	
CO_2	9.5	0.095	×	0.12341	= 0.01155
CO	30.5	0.305	×	0.07806	= 0.02380
N_2	60.0	0.600	×	0.07807	= 0.04690
Pounds per cu ft at 32 F and 30 in. Hg = 0.08225					
Let temperature in main = 90 F					
Let pressure in main = 0.5 in. Hg					
Partial pressure, aqueous vapor at 90 F = 1.42 in. Hg					
$\frac{0.08225 \times 29.1 \times 492}{30 \times 550}$ = 0.07120					

Figure 2 — Schematic diagram of cotton or glass cloth bag filtration apparatus.



1 cu ft aqueous vapor at 90 F = 0.00213

Wa at 90 F and 29.1 in. Hg 0.07330 lb per cu ft

Having collected and weighed a dust sample, the calculation of test results will proceed as follows:

Total volume of sample (cu ft) at test conditions of temperature and pressure	= 70.0
Average pressure of test meter in in. Hg	= —1.1
Average temperature of test meter in in. Hg	= 80 F
Total weight of dust collected, grams	= 0.0242
Grains per gram	= 15.43
Absolute temperature	= 460 F
Absolute pressure (observed barometer) in. Hg	= 30.0

$$\frac{70 \times 28.9 \times 520}{30 \times 540} = 64.8 \text{ cu ft at 60 F, 30 in. Hg}$$

$$\frac{0.0242 \times 15.43}{64.8} = 0.00577 \text{ grains per cu ft}$$

WET SCRUBBING AND FILTRATION METHODS

The separation and collection of dust may be accomplished by several different methods, the most practical for routine test purposes being by scrubbing with water or by dry filtration. The scrubbing method, as described in the following, is a modification of the apparatus and method originally used by R. R. Harmon. This apparatus (Figure 1) consists of three 450 x 75 mm ringneck cylinder scrubbing towers, a paper thimble filter, and two orifice-type gas meters, M_1 and M_2. The paper thimble filter is necessary to correct for the inefficiency of the wet scrubbers.

Gas is passed through the scrubbers at a velocity of 100-200 cu ft per hr and is measured in the first meter (M_1). On leaving M_1 part of the gas is by-passed through the filter thimble and measured in the second meter (M_2). The dust collected in the filter thimble, being an aliquot part of the total sample, is calculated to the volume of the total sample and added to the weight of the dust collected in the wet scrubbers for the purpose of calculating total amount of dust per cubic foot.

This method is of particular value where a physical and chemical evaluation of the dust is involved, or where a long continuous sample is required. By the very nature of the collection method, we have here a separation of:

1. Heavy insoluble residues.
2. Water-soluble residues.
3. Fine residue or fume, which passes through the wet scrubbing process.

The sum of these three residues comprises the total dust content of the sample measured. The laboratory technique involved in this determination includes the use of distilled water for the scrubbing towers and the precise drying and weighing of paper extraction thimbles in preparing for the test, as discussed later in this paper. After the sample has been collected, the following procedure is used in the residue determination:

1. The sample tube, rubber tubing and wash towers are washed into 1000-ml beakers, and the solution is filtered through dried and weighed fritted glass or gooch filters into 1000-ml beakers. The filtered residue is dried, cooled, weighed and recorded as "heavy insoluble residue."

2. The filtrate is evaporated nearly to dryness in the 1000-ml beakers and then transferred to weighed 250-ml pyrex evaporating dishes and taken to dryness in an oven at 210-220 F, after which it is cooled, weighed and the residue recorded as "soluble residue."

3. The paper extraction thimble must be dried for 5 hours at 220 F, cooled in a dessicator for exactly one hour, and weighed. This residue is recorded as "dry fume."

The results shown in Table I give an interesting picture of the physical constituents of blast furnace dusts as determined by the wet scrubbing method just described.

Filtration methods for dust determination are numerous. The filtering media used include glass wool, sugar, cotton flannel bags, and paper extraction thimbles for gases below 220 F, and alundum extraction thimbles or shells and woven glass wool bags for high temperature gases, such as raw blast furnace gas, boiler and furnace flue gases.

Glass wool filtration is simple but inefficient, and should be used only where equipment is limited or approximate surveys are sufficient.

SUGAR-FILTRATION METHOD

A method of filtration utilizing sugar as filtering medium developed at the Sparrows Point plant of Beth-

TABLE I

Source	Total dust composition, per cent			Total dust grains per cu ft
	Heavy insoluble residue	Dry fume	Soluble residue	
1. Hot blast furnace gas leaving the cyclone dust collector	61.0	17.0	22.0	1.969
2. Blast furnace gas leaving the primary scrubber	23.5	30.8	45.7	0.256
3. Blast furnace gas leaving the secondary scrubber	15.0	49.2	35.8	0.011

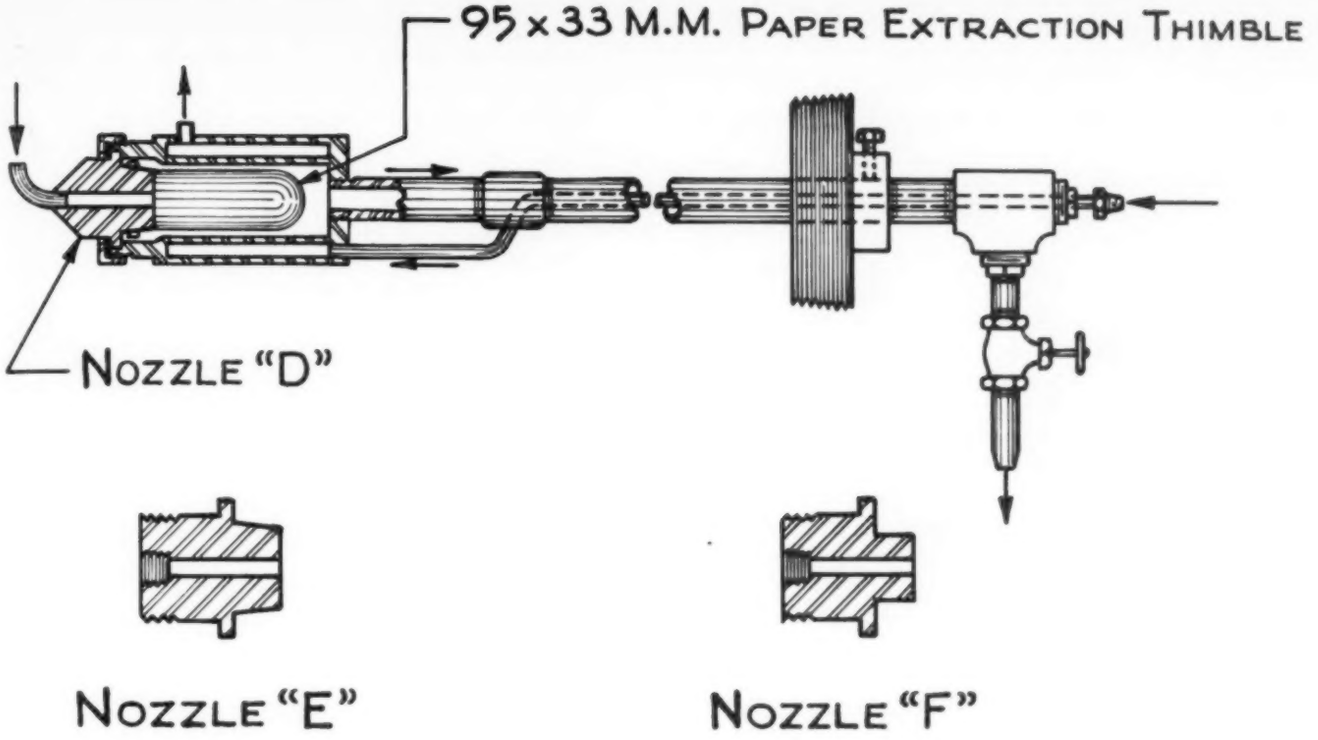


Figure 3 — Arrangement of dust determination apparatus employing paper extraction thimble.

lehem Steel Company was described by D. G. Hisley in the *Iron and Steel Engineer* of June, 1945. According to Mr. Hisley this method was developed on account of deposition of salt on the paper thimbles, caused by a high salt content (350 to 400 grains per gallon) in the service water used in scrubbing the gas. We will quote Mr. Hisley in describing this method:

"Basically, the equipment used in the new method consists of a glass sampling tube, a 300 ml Erlenmeyer flask containing 25 ml of distilled water, a 1½ in. by 8 in. glass tube filled with sugar, a gas meter, an eductor siphon, and rubber connecting tubing.

"The sampling tube is equipped with a stopper to hold the tube in place while the sample is being taken. The Erlenmeyer flask catches large particles of dust and some of the entrained moisture in the gas sample. The rubber tubing connecting the equipment is in short sections connected to each other by glass tubing to facilitate washing.

"The volume of gas that may be sampled varies with the quantity of dust and moisture in the sample. As the sample is being taken, the sugar in the sampling tube will begin to dissolve and discolor. This action will take place first at the top of the tube and gradually work toward the bottom. When the sugar begins to discolor and dissolve near the bottom of the sugar tube, the sampling tube is withdrawn, and the gas meter stopped simultaneously."

The sampling having been completed as described, the equipment is all washed and the wash water and sugar solution filtered through a gooch crucible, dried, and weighed. The operations and determinations involved in the sugar-filtration method are very similar to those of the water-scrubbing method previously described, except for the evaporation of the filtrate.

As previously noted, this filtrate is purposely discarded in order to compensate for errors due to contamination with salt introduced through wash water in the gas scrubber. Elimination of this error by discarding the filtrate also prevents the inclusion of soluble dust or fumes which, according to our previous description of the wet scrubbing method, consists of 22 to 45.7 per cent of the total dust in blast furnace gas, depending on the location of sampling. This method should therefore only be applied where indicated by excessive entrained scrubber water with a high content of dissolved solids.

COTTON BAG FILTRATION METHOD

A cotton bag filter may be used with gases below 220 F where high dust concentrations or a large quantity of entrained water foul other types of dry filters. For temperatures greater than 200 F woven glass-wool fabrics, substituted for cotton, will give very satisfactory results.

An apparatus adaptable to bag filtration is illustrated in Figure 2. This apparatus was originally used for determinations of primary scrubbed blast furnace gas and is capable of filtering several hundred feet of gas without a serious increase in back pressure. Where the facilities for providing the necessary electrical heating coil are limited, this feature may be eliminated by substituting a steam jacket. This apparatus is also ideally suited for long continuous sampling of other industrial and atmospheric dusts, to obtain samples for ordinary chemical analysis and micro-analysis. For such applica-

tions it is usually unnecessary to meter or to use heat to prevent condensation.

PAPER THIMBLE METHOD FOR BLAST FURNACE GAS

The paper thimble method for dust determination in blast furnace gas, either primary or secondary washed, as described here, is a modification of the Brady thimble method. It involves the use of a steam-jacketed extractor body, Figure 3, with a short sampling tube or nozzle (D) or an adaptor nozzle (E) for use with an extended conventional sample tube, both designed for paper extraction thimbles. Part F is designed for use with alundum thimbles or woven glass cloth bags.

The assembly A in Figure 3 shows the apparatus equipped for insertion into the gas main through a 4 in. pipe assembly. A 4 in. pipe plug is used in placing the sampling tube in the proper position. It controls both the depth of immersion and the direction of the nozzle (D) into the gas stream.

The half-inch standard pipe which connects the extractor body (B) with the gas outlet serves to carry the filtered gas to the meter and aspirator, and provides condulet protection to the quarter-inch copper steam-supply tube to the steam jacket on the extractor body.

The sample nozzle, (D, E, or F) is attached to the end of the extractor body by means of an extractor collar, the union being sealed with a thin rubber gasket. The extractor body should be made from rolled tube or bar stock, preferably steel, and must be very carefully checked for porous leaks or other imperfections by application of pressure under water.

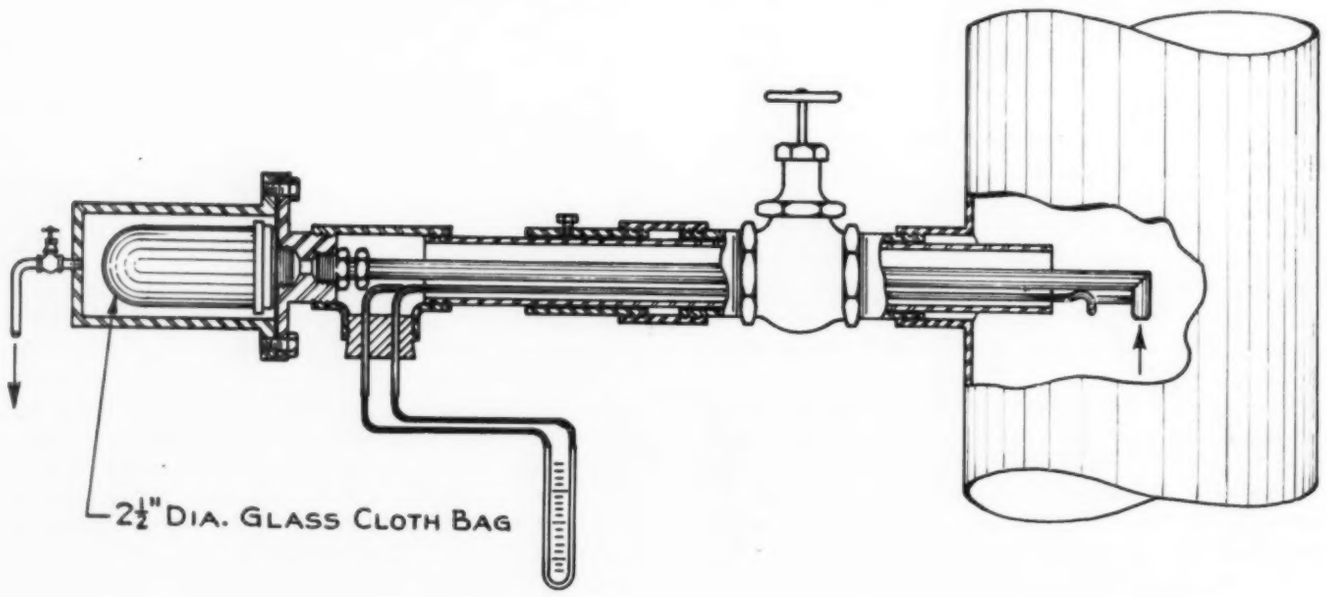
The apparatus required for a complete dust determination consists of the following parts and accessories:

1. Sufficient log sheets to precisely cover all data required for the test.
2. Two sample tubes complete (Figure 3).
3. Whatman extraction thimbles, 95 x 33 mm.
4. One dozen 118 x 40 mm glass weighing bottles with ground glass stoppers.
5. Two laboratory test meters, either wet or dry, capacity 50-100 cu ft per hr, equipped with a 0 -150 F thermometer and a 6 in. mercury manometer.
6. Two glass cooling towers.
7. Two aspirators. (Figure 8).
8. Pitot tube.
9. Inclined draft gage for pitot tube readings.
10. Analytic balance, sensitivity 0.5 mgm.
11. One drying oven, preferably electric, thermostatically controlled to hold a temperature of 225 F.
12. Forceps and crucible tongs for handling thimble and weighing bottles.
13. A carrying case for weighing bottles. (If convenient, the safest procedure is to remove and replace thimbles from the extraction body in the laboratory, thus eliminating handling in the field).
14. A stop watch.
15. A barometer.
16. A U. S. Bureau of Mines approved "all-service" gas mask.

A careful pitot tube traverse of the main prior to sampling is essential, as it will give a fairly accurate picture of the prevailing flow conditions, although this is not sufficient to show the best average location for sampling.

The traverse completed, the next and most important step is that of taking simultaneous samples in the same horizontal section but in different segments. Only by this procedure is it possible to locate the portions of a segment where the average dust concentration will predominate, because the dust content of the gas will vary considerably throughout the cross-sectional area and especially in short straight runs in the immediate vicinity of pipe bends, valves, orifice plates, or other internal irregularities.

Figure 4 — This improved dust determination apparatus is equipped with static pressure indicating nozzles.



To start the test, the pitot tube is inserted and the velocity pressure at the point of sampling checked. The sample tube is inserted into the main, with the nozzle pointing down stream, and then connected to the cooling tower, the meter, and finally to the aspirator. With the rate of flow through the meter calculated from the pitot tube reading in seconds per revolution (S in formula 5) and corrected for line and meter temperature and pressure, (S_1 in formula 6), the tube is turned so that the nozzle points up stream and the flow adjusted through the meter, using the stopwatch frequently to maintain this flow uniformly. If the flow in the gas main is uniform, the test flow will require little adjustment. If the flow is irregular in the gas main, the pitot tube connection must be maintained permanent, and frequent adjustments must be made to keep a proportionate flow in the nozzle of the sample tube, as calculated for S on the meter.

In the determination of the dust content of secondary washed gas the finest technique must be used at all times. The proper handling of the extraction thimbles is absolutely essential to uniform accuracy of determinations. With the average weighing bottle stopper and thimble weighing about 75 grams, and the weight of the collected dust residue ranging from 0.050 to 0.250 grams, it can be readily understood how the slightest carelessness in handling will introduce large errors.

Thimbles taken from the drying oven and cooled over calcium chloride will absorb as much as 2 mgm of moisture per hour over a period of 10 hours. Duplicate thimbles cooled over concentrated sulphuric acid will absorb 0.5 to 1.0 mgm per hr. In order to compensate for these errors, it is therefore necessary always to run a blank thimble through the drying and cooling processes and use the weight deviations thus determined as corrections for the corresponding samples.

From the standpoint of technique, the following points, if carefully followed, will guarantee accurate results:

1. Never handle a thimble or weighing bottle with bare fingers. Always use a piece of clean, dry paper towel, forceps, or crucible tongs.

2. Particles of the thimble fibre which might stick to the nozzle after removal of the thimble, and dust adhering to the sample nozzle must be carefully brushed back into the thimble. The latter can be best handled by using a $\frac{3}{8}$ or $\frac{1}{4}$ in. round hair-bristle burette brush.

3. The drying time, drying temperature and cooling time in the dessicator must be held uniform, both before and after sampling, as follows: Dry the thimbles and their respective weighing bottles at 225 F for 5 hr. Then place the thimbles in the weighing bottles, close the lids, and transfer into a dessicator, which has been charged with a fresh dessicant, to cool for exactly one hour.

Fresh fused calcium chloride, re-activated alumina, silica gel, and concentrated sulphuric acid are all good dessicants, but the use of concentrated sulphuric acid should be avoided because of the hazard of spilling or breakage. Calcium chloride is good if used from a fresh container or after baking at 250 F for 10 hr. This also holds true for granulated alumina and silica gel. Silica gel, treated with cobalt nitrate, is excellent because the cobalt nitrate acts as an indicator, changing from blue to pink when the moisture content becomes high enough to decrease the drying efficiency.

4. Before a thimble is removed from the dessicator for weighing, the approximate weights are set on the balance. The weighing bottle with the thimble is then placed on the pan and, after raising the lid of the bottle sufficiently to equalize the pressure (this is usually done during the transfer from the dessicator to the balance), the lid is reset and the bottle weighed quickly.

5. The sample tube assembly should always be checked for leaks before it is inserted into the gas main, by connecting it to the meter and aspirator and drawing a vacuum of 5 in. of mercury, holding the nozzle shut with the finger. After the tube and meter have been exhausted to 5 in. Hg, the meter hand will remain motionless, provided there are no leaks. If the hand continues to move, the leaks must be located and stopped before the test can proceed.

6. PLAY SAFE. If there is any indication of gas leaks in the vicinity of the test, an approved gas mask should be worn when the test equipment and the sample tubes are set up. The operator should then move on to a gas-free area, returning at intervals of 5 to 10 min to take readings and make flow adjustments.

IMPROVED METHOD FOR DETERMINATION OF VARIOUS TYPES OF DUSTS

The need for a sturdy and versatile sampling apparatus for use in the determination of dust in various hot or dry, cold gases, such as open hearth furnace and boiler furnace stack gases, sintering plant stack gas, and miscellaneous gases producing nuisance dusts, resulted in the design and use of the apparatus illustrated on Figures 4 and 5. This is a heavy unit equipped with a $1\frac{1}{4}$ in. pipe condulet for protection of the sampling tube and pressure tubes. It is equipped with a 2 in. extra-heavy pipe sleeve and set screw to lock it in position after insertion through the 2 in. gate valve, which is connected permanently to the sampling sleeve on the gas main or stack. The collection head on this sampling tube is not heated externally because the gases with which it is used are either hot (250-500 F) or cool and dry. If gases are cooler than 250 or condensation occurs in the collector head, then the head should be insulated, preferably with hair felt. If necessary, it can be steam jacketed as in Figure 3.

The apparatus shown in Figure 4 was originally designed for use with 45 x 127 mm alundum thimbles, but the recent design and development of woven glass-cloth bags has proved this material so superior as to permissible dust capacity, constant back-pressure and accuracy, that it is the writer's opinion that the alundum thimble will be retired to obsolescence. Simultaneous samples of open-hearth stack dust showed 25 to 50 per cent more dust with glass-cloth bags than with alundum thimbles. The reason for this may be explained by the rupture of the soft asbestos seal required to seat the alundum thimble after the back pressure has in-

creased because of the penetration of the fine oxide fume into the pores of the alundum thimble.

Due to the diversity of gas flows encountered in this miscellany of determinations, this sampling nozzle is equipped with two static pressure tubes. One is connected ½ in. in from the nozzle tip and indicates the pressure in the sample nozzle. The other is connected externally to the rear of the sample nozzle and indicates the line pressure. When the two tubes are connected across a U-tube containing water and the indicated differential pressure maintained at zero by manipulation of the outgoing ¼ in. gate valve, if there is sufficient pressure in the system, or by manipulation of the aspirator capacity, if an aspirator is being used, the velocity in the sampling nozzle will be equivalent to the velocity in the gas main or stack.

This method of flow control was originally described in "Methods of the Chemists of the U. S. Steel Corporation for the Sampling and Analysis of Gases," (Third Edition, 1947), and eliminates the necessity for pitot tube readings and calculations, as previously described.

The collector adapters illustrated in Figure 5 are interchangeable and can be applied as follows:

Adapter C for use with 95 x 33 mm Whatman paper extraction thimbles.

Adapter D for use with 45 x 127 mm coarse alundum thimbles.

Adapter E for use with 90 x 140 mm woven No. 032 GR glass-cloth bags. Figure 4, illustrates a woven glass-cloth bag attached to adapter E by use of a simple clamp.

TEST METERING

The measurement or metering of gases for the various test purposes described may be accomplished by the use of three types of meters:

1. Orifice test meters (Figure 6).
2. Laboratory wet test meters.
3. Dry or diaphragm test meters.

The orifice test meter illustrated on Figure 6 was originally designed and calibrated for use with the wet scrubbing method (Figure 1). It consists of an interchangeable orifice assembly joined by a union collar or coupling sleeve (D) and orifice plates E and F. The inlet and outlet ends may be fitted directly to ⅜ in. inside diameter rubber tubing or threaded for ¼ in. standard pipe connections. The pressure connections are connected by ⅛ or 3/16 in. laboratory tubing to U-tubes, as illustrated in Figure 1, for observation of gas pressure and differential.

The 5/16 in. orifice is being applied to the measurement of the total gas and the ⅛ in. orifice to the measuring of the aliquot to the thimble filter. It provides a versatile means of measuring various flows of gases, but it is only accurate to the degree of pressure observation and recording applied during the test; it is not to be recommended for pulsating flows.

The following formulae for the use of this meter are correct, the orifice co-efficients having been derived by calibration of the meter against direct displacement of gas by water in a 50 gal calibrated container:

$$V = 66.2\sqrt{\frac{H}{S}}$$

$$R = VA$$
$$Q = K(Rt)$$

where V = velocity (feet per second)
H = differential head (inches of water)
S = specific gravity of gas at observed temperature and 30 in. Hg, saturated with water vapor.
R = rate of flow (cu ft per sec).
A = area of orifice.
(⅛ in. diameter = 0.000085 sq ft)
(5/16 in. diameter = 0.000532 sq ft)
Q = total volume (cu ft)
K = orifice co-efficient (⅛ in. = 0.594)
(5/16 in. = 0.603)
t = total seconds.

Laboratory wet test meters may be used for dust determinations if available with sufficient capacity. A 50 cu ft per hr meter may be overloaded to a capacity of 100 cu ft per hr and will prove satisfactory for most purposes. The smaller test meter commonly used in calorimetry is not of sufficient capacity and should not be used for dust determinations.

Wet test meters are very sensitive to water-level change and should be calibrated before each test and the water level adjusted for correction. A simple device for this purpose in the laboratory or in the field consists of a three-liter aspirator bottle connected from the outlet of the meter to the top neck and a two-liter volumetric flask to receive and measure the water displaced.

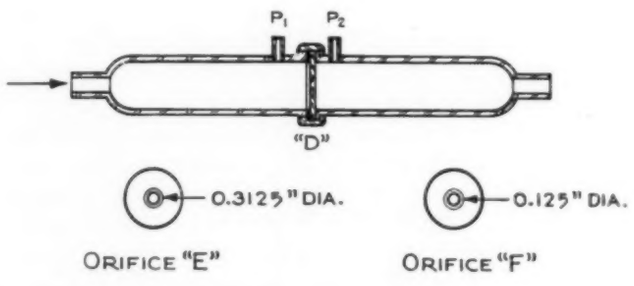
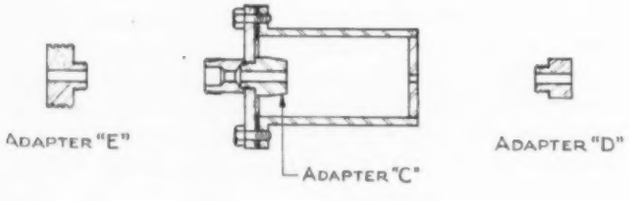


Figure 6 — General arrangement of test meter of 200 cu ft per hr capacity.

Figure 5 — Sketch of dust collector head, showing interchangeable filter adapters.



With the meter pointer set to zero and the aspirator bottle filled with water and set below the level of the meter, a rubber tube connected to the bottom neck of the aspirator bottle is lowered into the volumetric flask and the water permitted to flow slowly into the flask and up to the calibration mark on the neck when the flow is stopped. The reading in cubic feet on the meter dial must be equivalent to two liters or 0.071 cu ft. If the reading is high, the water level in the meter must be decreased; if low, water must be added.

Most of the inconveniences common to the wet test meter are eliminated by the use of a dry or diaphragm test meter. These meters are built on the same principle as a domestic gas meter, and being dependent on an oiled skin diaphragm rather than a water-level seal,

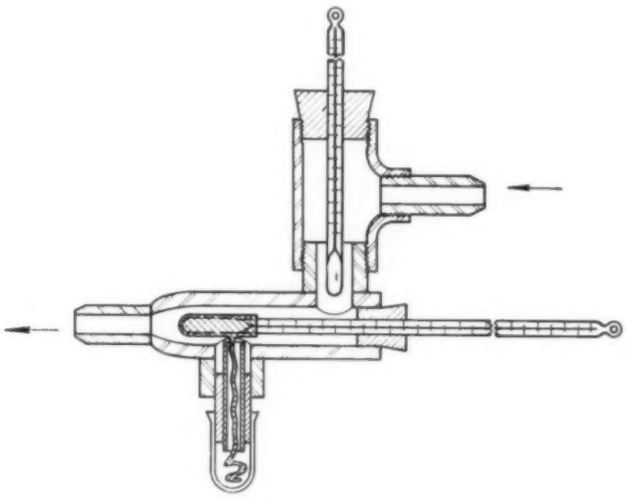


Figure 7 — Arrangement of wet and dry bulb thermometers that may be used to measure moisture content of gas stream.

they may not be quite as accurate as a laboratory water test meter. However, they are much more rugged and reliable for field work. These meters may be calibrated the same way as described for the wet test meter, but must be returned to the factory for repairs and accuracy adjustments.

MOISTURE DETERMINATION

Moisture occurs in gas in three forms:

1. Normal saturation, or that quantity of water vapor present by virtue of saturation to maximum temperature and pressure equilibrium.
2. Entrained moisture consisting of small particles of water present by virtue of the buoyancy sustained by a high velocity of the gas.
3. Supersaturation, which may be due to a drop in temperature below the dew point in low-temperature gases, or the actual presence of steam as in drying-oven atmospheres.

The simplest method of determining moisture in air

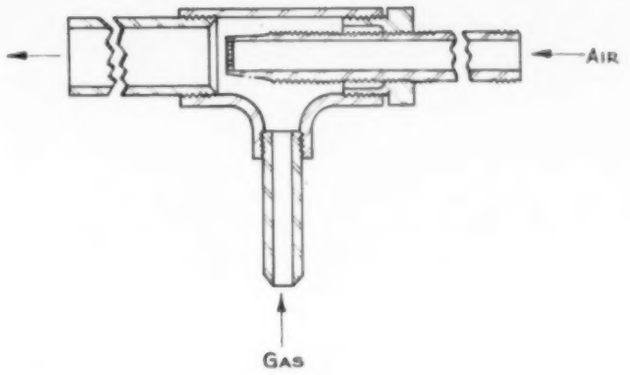


Figure 8 — General arrangement of test aspirator for use with air or steam.

involves the use of a sling psychrometer equipped with wet and dry bulb thermometers. A psychrometric table is used for conversion of the temperature observed to relative humidity, or per cent saturation, 100 per cent being equivalent to the maximum moisture possible at the prevailing condition of temperature and barometric pressure.

Entrained moisture or supersaturated moisture in low temperature gases is best determined by passing the gas through an efficient desiccant, such as fresh dehydrated calcium chloride, calcium sulphate, or silica gel. After a metered sample has been passed through the drying train, the towers are weighed and the moisture calculated to the accepted terms, usually grains per cu ft.

If the moisture content of a gas being tested for dust is required, the drying train can be installed between the dust sampling tube and the meter. If a moisture determination is required on a gas which is not being filtered for dust determination, but carries sufficient dust to impair the accuracy of the moisture determination, then it is necessary to improvise filtration which will have to be insulated and heated to prevent moisture precipitation in the dust filter. In hot gases such filtration can be accomplished by means of a filter tube loaded with glass wool or shredded asbestos or by the use of a porous stone filter tube. Such tubes will not become wet because they are immersed in the source of sampling.

A simple apparatus for the determination of saturated moisture in hot gases, such as foundry drying ovens, may be constructed as follows:

A graduated cylinder, 25, 50, or 100 ml, is attached to the bottom tube of a reflux condenser, which is equipped with a tee connection permitting gas to enter at the bottom near the return to the graduated cylinder. The outlet, or top tube of the reflux condenser, is connected through a meter to an aspirator. The cooling jacket of the condenser is connected to cold, clean water.

With this apparatus, continuous periodic tests can be made showing the moisture content and drying characteristics of the atmosphere during the various stages of the drying cycle. The water collected may be measured or weighed, depending on the required accuracy.

Modern Cold

. . . . present cold drawing is based upon an old principle, but improvements in the equipment, auxiliaries and control have made the process efficient and economical . . . .

▲ THE art of cold drawing is more than 100 years old, and is at present the most economical method for producing cold finished bars and tubes. Many methods of producing cold finished tubes have been developed but none has been able to equal the production or the overall flexibility of the mechanical cold drawbench. The modern drawbench still embodies features of the first machine, but auxiliary equipment for bar and tube handling has been developed in the past few years to make the "one-man" drawbench of today a high production machine.

It has even been said that someday a machine will be invented to replace the drawbench. Before this happens, if indeed such a radical change ever is made in the cold draw industry, it is safe to say that many more millions of feet of bars and tubes will be drawn on mechanical cold drawbenches before such a machine is developed.

There are in this country drawbenches even today which are driven by belt and pulley, and there are also batteries of benches still being driven from one line shaft. The cold draw industry recognizes the need for replacing these old machines with high production equipment, since such equipment is essential if any company is to remain in a competitive position in this era of high labor costs.

Production as obtained today from modern benches is as much as two to three times the output of most drawbenches less than ten years old. The increased chain speeds, larger driving motors, heavier reductions, high speed carriage return, and improved handling equipment for bars and tubes on the bench are essential to present day high bench output.

The drawbench is a machine used in a cold working process in which bars, rods, tubes or shapes are pulled through a die to obtain reductions in cross sectional area, to impart to the material special physical properties, or to obtain a finished surface to close tolerances without machining.

Presented before AISE Annual Spring Conference, Philadelphia, Pennsylvania, May 26, 1947.

Tube drawbenches now in operation range in sizes from 1000 lb pull up to 300,000 lb pull; they are used for drawing tubes ranging from $\frac{1}{8}$ in. up to 16 in. outside diameter.

Benches for cold working bars range from 10,000 lb pull up to 100,000 lb pull, on which bars or rods $\frac{1}{4}$ in. to 6 in. diameter are being drawn.

TUBE BENCHES

Various types of tube drawing benches are available today, including:

1. Single chain, single mandrel rod end, for single draw; normal size range 200,000 lb to 300,000 lb.
2. Single chain, double mandrel rod end for single draw; normal size range 5000 lb to 200,000 lb.
3. Single chain, six mandrel rod end for triple draw; normal size range 10,000 lb to 200,000 lb.
4. Dual chain with six mandrel rod end for triple

Figure 1 — Installation view of single mandrel 300,000 lb drawbench with loading rack and tube pusher.

Drawn Equipment

By G. W. GARWIG and
A. L. THURMAN
The Aetna-Standard Engineering Company
Youngstown, Ohio

draw; normal size range 10,000 lb to 60,000 lb.

5. Rack type with six mandrel rod end for triple draw; normal size range 3,000 lb to 12,000 lb.

To illustrate the various parts of a drawbench, Figure 1 showing an existing 300,000 lb drawbench installation will be used. The bench shown is a single chain, single mandrel rod end type. The carriage has just completed drawing one tube which is shown in the bucks; the skid arms are extended across the bench in the position where they support the tubes when the draw is completed. A second tube is shown over the mandrel rod with the point extended through the die ready for the next draw. The next tube is in the pusher trough ready to be loaded on the mandrel rod when the draw is completed and other tubes are on the loading rack ready to be fed into the pusher trough.

As installation view of two single chain benches with a double mandrel rod extension on the single chain bench has proven to be very popular, since it permits the operator to draw one tube while he feeds another tube on the other mandrel rod.

The dual chain bench which is shown in Figure 2 is the latest design bench and is capable of drawing one, two, or three tubes simultaneously while the other rods are being loaded with tubes from the next draw. The outstanding features of this bench are that discharge arms and carriage return drive are eliminated and that a more compact unit can be designed. Note that the motor for this bench is mounted above the chain. By using two chains it is possible to eliminate the discharge arms and allow the tubes to drop straight down on to a sloping deck from where the tubes slide into receiving racks located alongside the bench. By reversing the main motor to return the carriage, a separate carriage return drive is eliminated.

The electric drive for all benches of this design has been variable voltage d-c with current limit control, which provides a rapid, smooth acceleration and controlled deceleration of the carriage.

The center line of pull on the dual chain bench is on the center line of the chain to provide a very smooth pulling speed, which is not possible on the conventional chain bench where the center line of draw is from 2 in. to 10 in. above the chain.

Figure 2 — Shop view of 12,000 lb reversing dual chain drawbench designed for drawing one, two or three tubes simultaneously.

In addition to the development of the above dual chain bench, rack type benches are available which are similar in appearance to the dual chain bench. This bench is shown in Figure 3, and has been furnished in ratings of: 3,000, 5,000, 7,500, and 12,000 lb pull. Its capacity has been limited due to the unavailability of a motor with sufficient horsepower in a small diameter frame. Other than this limitation, the rack type bench has some advantages over the dual chain, since it is possible to eliminate completely all chains and at the same time, the pulling head, drive, and motor are combined into one unit.

Rack type and dual chain benches now in operation are producing approximately 250 per cent more tubes than the conventional single chain, single draw, bench. The electric equipment for the rack type bench, except for the main motor itself, is usually of the same general type as that used on the dual chain bench.

Triple drawing of larger size tubes has recently been made available to the industry with the introduction of single chain triple draw tube drawbenches in sizes up to 200,000 lb. These larger benches are usually equipped with automatic mandrel rod ends, elevating type load-

Figure 3 — Rack type 3000 lb drawbench designed for drawing one, two or three tubes simultaneously.

ing racks, new type discharge arms and box type carriages with removable drawing heads for single, double and triple draw.

The triple drawing of all sizes of tubes has greatly emphasized the need for improved tube handling facilities in the cold draw industry. One of the toughest bottlenecks to break in maintaining full production on high speed triple draw benches is the problem of keeping the bench supplied with tubes. This problem will likely be solved by the use of conveyors which will move tubes to the loading rack before draw and away from the bench after draw.

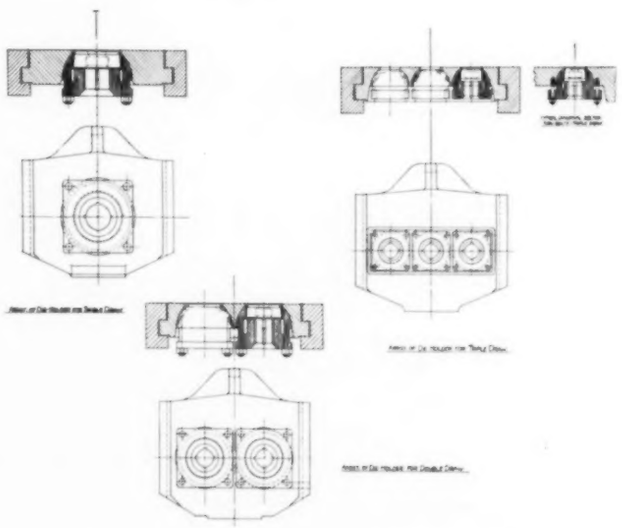
Die mountings are furnished to suit the customer's dies, which may be tapered or cylindrical, mounted in a heavy cast steel holder. Spherical seat die mountings are desirable and are recommended for all benches. This type of mounting allows the operator to rock the dies in such a way that straight tubes or bars can be drawn. Figure 4 shows a typical spherical seat die mounting for single, double and triple draw.

A considerable amount of design work and research has been spent in the development of tube loading racks to provide for larger bundles of tubes, since most plants of today are not equipped with sufficient crane service to keep up with the high production benches of today. The elevator type loading rack with pusher is used on all sizes of benches from 50,000 lb up to 200,000 pull. They are normally designed to take a 5-ton load of tubes and yet the rack does not add greatly to the overall space requirements of the bench.

Figure 5 shows a dual type loading rack recently put into operation in a large brass and copper tube plant. This type of loading rack provides an additional tube reservoir and allows the loading of the back pocket while the operator is drawing tubes from the front pocket. With this arrangement the operator is able to maintain the bench in more nearly continuous operation when crane service is slow, by transferring the load of tubes from the back pocket to the front pocket.

Figure 6 shows a proposed layout for the drawing of steel tubes over a bar. This unit consists of a 50,000 lb single chain drawbench, a reeling machine, a 12,000 lb rack type bench, a reeler inlet table, a reeler outlet table

Figure 4 — Typical spherical seat die mountings for single, double and triple draws.



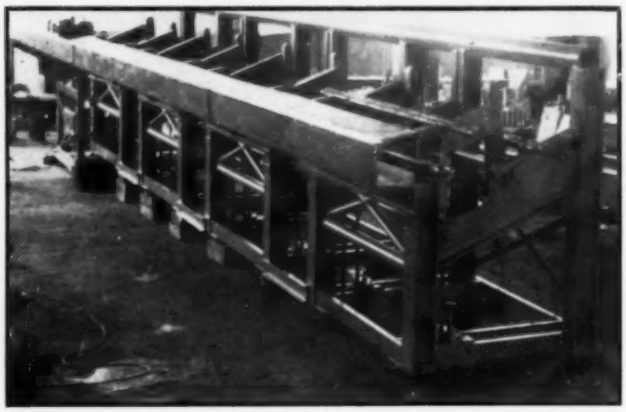


Figure 5 — Dual type loading rack for 75,000 lb drawbench.

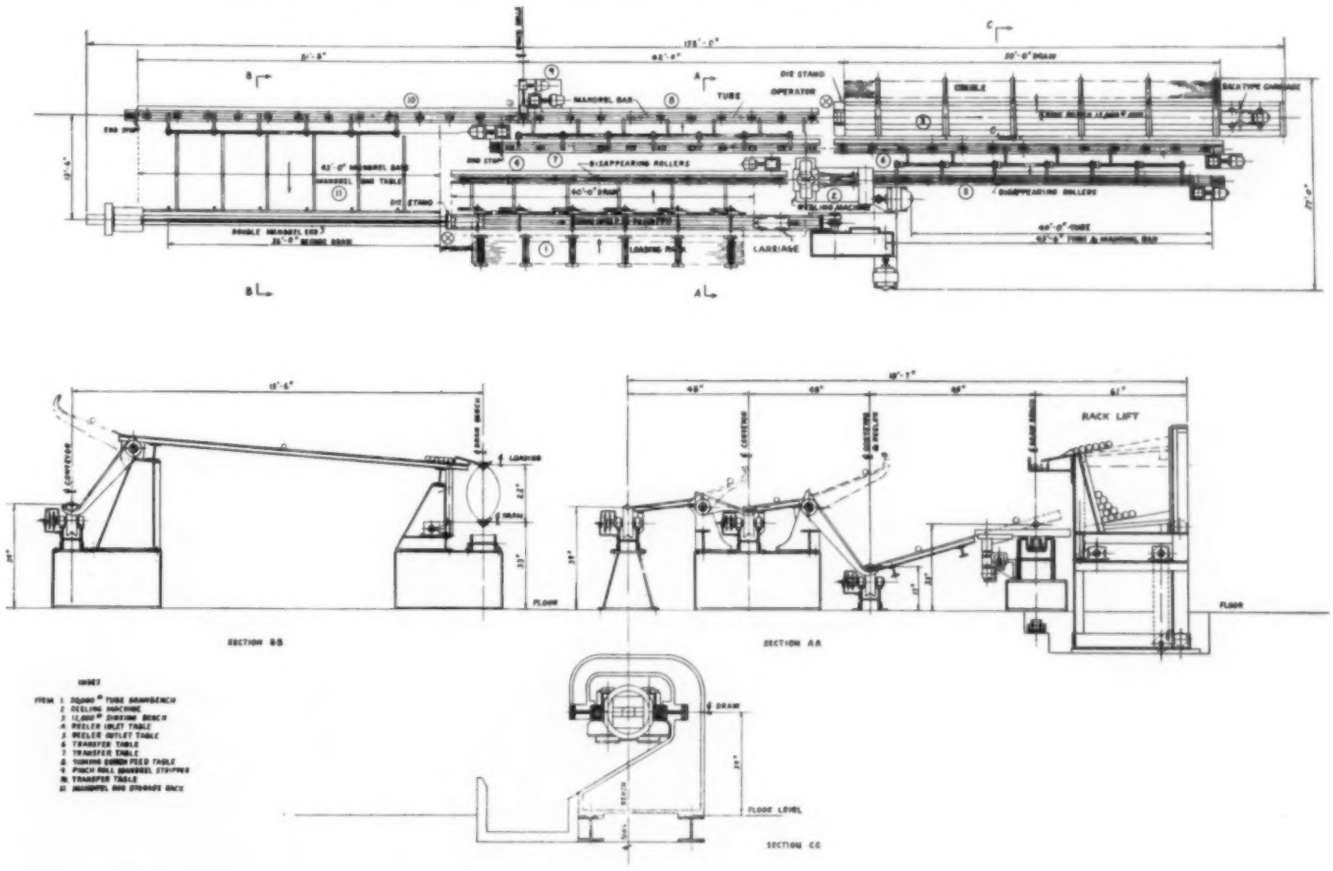
with kick-out, two transfer tables, one with kick-out, a drawbench feed table, a pinch roll mandrel stripper, a mandrel bar transfer table with kick-out, and a mandrel bar storage rack.

The operation of this unit is as follows: A number of mandrel bars is placed on the mandrel bar table and a bundle of tubes is placed on the 50,000 lb drawbench loading rack.

To start the cycle of operation a bar is fed into the upper mandrel trough by means of an air operating feeding device. A tube is rolled by hand into the pusher trough and threaded over the bar by a pusher. The mandrel end is then transferred, bringing the loaded trough into line with the die. The carriage is returned to the die stand while an air operated pusher places the point of the tube in the die. When the carriage reaches the die stand, it automatically grips the tube point and starts the draw. While the drawing operation is in progress, another rod is fed into the upper mandrel trough, and another tube into the pusher trough and over the mandrel bar. At the end of the draw the bar and tube are discharged from the bench onto inclined skids leading to the reeler inlet table. When the tube reaches its position on the inlet table the roll drive is started to bring the end of the tube into position between the reeler rolls. As the reeler drive motor picks up load, a load relay automatically retracts the inlet and outlet table rollers to prevent marring the tubes. When the tube has completed its passage through the reeler the load relay automatically returns the table rollers to move the tube longitudinally to clear the reeler and where the end of the tube strikes a flag switch to operate the kick-out arms. These kick-out arms place the tube on the transfer tables which move it longitudinally into alignment with the sinking bench feed table. At this point the tube strikes another flag switch and is rolled onto the feed table by means of kick-out arms.

To strip the tube from the mandrel bar, the tube and bar are advanced by hand toward the pinch roll unit until the end of the bar is between the rolls. A "U" shaped stripper plate is then dropped into slots in the bed betwen the pinch rolls and the end of the tube. At

Figure 6 — Proposed layout showing equipment for drawing steel tubes on a bar.



this point the pinch rolls are closed on the end of the bar, stripping the bar from the tube and running onto the runout table where it is carried forward into line with the mandrel bar storage table. Here the bar strikes a flag switch which operates a set of kick-out arms to discharge the bar onto the feed table.

The tube is moved by hand into the die of the sinking bench, the sinking pass is made, and the finished tube is discharged into cradles alongside the bench to complete the cycle.

BAR BENCHES

While the bar bench has not been as spectacular in its development as the tube bench in the past few years, certain improvements which have been made to the tube bench are also applicable to the bar bench; however, certain spectacular developments have been made which are unique to the bar bench itself. Figure 7 shows an overall view of a 50,000 lb conventional bar bench designed for drawing one, two or three bars simultaneously.

Ordinarily, few material handling facilities are furnished as a part of the bar bench. The bar handling equipment usually consists of a simple structural steel rack in back of the die stand for supporting the bars before they are fed into the die. It should be noted that the main drive carriage, carriage return, skid arms and draw sections are identical with the tube bench.

A drawbench may be equipped with a pull-through shear, which enables the operator to draw straight lengths from coils. This shear is swung to the side of the bench as the carriage approaches the die at the start of the draw. As the carriage moves away from the die, the shear is automatically swung back into the position where it is ready to cut the bars to length. The length of sheared bar is determined by the location of a limit switch which is movable along the length of the carriage bed.

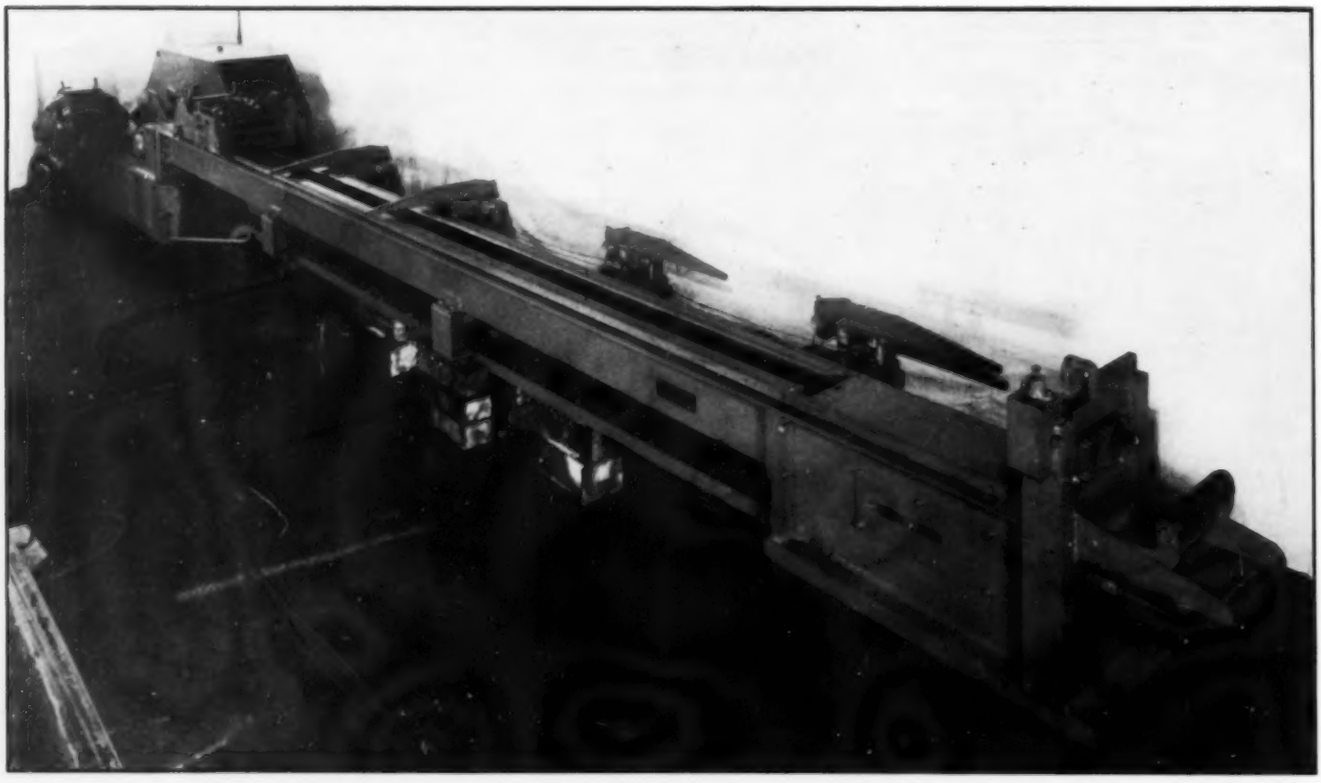
The dual chain and rack type bench mentioned above have not been built for the bar industry to date, but either type of bench will readily lend itself to bar drawing.

PRODUCTION

The production from either a tube or bar bench depends not only on drawing and carriage return speeds, but as well to a great extent on the handling of material to and from the machine. Benches in operation today which draw one tube while the operator is loading another mandrel rod are producing at an average of 3,500 ft of tubing per hour. This production is based on a draw speed of 100 fpm and carriage return speed of approximately 350 fpm.

On dual chain and rack type benches, production as high as 12,000 ft of tubing in one hour has been reached. This production was obtained at drawing speeds of 150 fpm and carriage return speeds of 325 fpm. These benches are averaging a total of 5000 ft per hr for an eight-hour day, including all down time.

Figure 7 — General view of 50,000 lb bar bench, showing four new type skid arms.



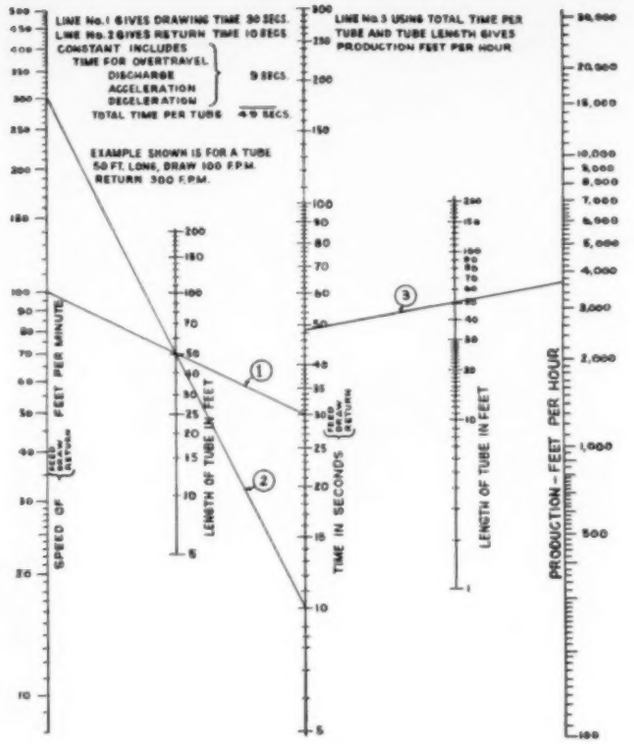

LINE No. 1 GIVES DRAWING TIME 30 SECS.
LINE No. 2 GIVES RETURN TIME 10 SECS.
CONSTANT INCLUDES
TIME FOR OVERTRAVEL
DISCHARGE
ACCELERATION
DECELERATION
9 SECS.
TOTAL TIME PER TUBE 49 SECS.
LINE No. 3 USING TOTAL TIME PER TUBE AND TUBE LENGTH GIVES PRODUCTION FEET PER HOUR
EXAMPLE SHOWN IS FOR A TUBE 50 FT. LONG, DRAW 100 F.P.M. RETURN 300 F.P.M.
SPEED OF FEED BACK RETURN FEET PER MINUTE
LENGTH OF TUBE IN FEET
TIME IN SECONDS
FEED BACK RETURN
LENGTH OF TUBE IN FEET
PRODUCTION - FEET PER HOUR
1
2
3

Figure 8 — Chart for calculating draw bench production.

Tubes being drawn on these two benches are $\frac{5}{16}$ in., $\frac{3}{8}$ in. and $\frac{1}{2}$ in. outside diameter.

As mentioned before, production is based on quite a number of variables and it is impossible for anyone to give specific figures unless these variables are known. For example, when drawing tubes 30 ft long, production will be at one rate, while if 60 ft tubes are drawn at the same speed, production will be still higher.

Figure 8 is a typical production chart showing most of the variables. As a specific example:

Line No. 1 gives drawing time	30 sec
Line No. 2 gives return time	10 sec
Constant—includes time for overtravel, discharge, acceleration, deceleration	9 sec
Total time per tube	49 sec

Line No. 3, using total time per tube and tube length, gives production feet per hour.

In Figure 9 is shown the estimated production for a 50,000 lb single chain, multiple bar drawbench.

DRAWBENCH POWER REQUIREMENTS

Tubes—The normal reduction in area in the cold drawing of mild steel tubing is between 20 and 40 per cent. It has been possible, however, by suitable heat treatment, careful pickling, improved plug drawing technique, improved steel production methods and careful choice of steel compositions to employ reductions as high as 50 per cent per draw. When the tubing is to be drawn on a bar, even greater reductions are possible, but the plug drawing method is most commonly used due to other production difficulties involved in drawing on a bar.

The power required to draw steel tubes is one of the most controversial subjects in the art of cold drawing; few cold draw plants have complete data available on horsepower requirements for the various sizes and different alloys of steel which they draw.

The actual horsepower required for making a draw is dependent upon so many variables that it is extremely difficult to arrive at consistent data from actual test results, no matter how much care is used in performing the tests. The inconsistency in test results is due to variations in die and plug friction, type and condition of lubrication, type of drawbench, condition and type of main drive, reductions to be made, condition of the material and speeds at which the work is to be done. Even in the course of drawing one tube, the horsepower readings may vary, due to change in eccentricity of the tube, variations in hardness and analysis of the steel.

The power required in tube drawing is made up of two main components, one of which is a function of the frictional resistance of the die and plug, the other and normally the main component which is due to the resistance of the metal to flow, which in turn is a function of the tensile strength of the material.

There have been a number of theoretical papers on power requirements for tube drawing but we have found that an empirical formula, backed by years of experience and substantiated by test results, is adequate for our purposes. In the same way, most operating plants have certain test data available on the power required to make a given reduction on the certain size and type of tube; this data, combined with operating experience, give the operating people data required for setting up their production schedules, or for the selection of new equipment.

To determine the pull required for making a given reduction, we use the following relationship:

$$P = Ar \times T \times C$$

where P = chain pull in pounds.
Ar = reduction in area.
T = tensile strength of material
C = constant.

Figure 9 — Chart giving production data for 50,000 lb drawbench.

50,000 LBS. DRAW BENCH - 40'-0" LG. BARS - MATERIAL 65,000 LBS. TENSILE

DIA. OF BAR	WEIGHT PER FOOT	DRAW FEET PER MIN.	DRAW TIME MIN.	IDLE TIME MIN.	TOTAL TIME MIN.	PERCENT EFFICIENT	NUMBER OF BARS	PRODUCTION LBS. PER HOUR	PRODUCTION TONS PER TURN	PRODUCTION TONS PER MONTH	PULL ON CHAIN LBS.	HP REQ'D.
5/8	1.50	80	.50	1.50	2.00	25.0	3	5,400	21.6	1685	37,391	91
1	2.67	80	.50	1.75	2.25	22.2	3	8,535	34.1	2660	49,335	120
1 1/4	4.17	80	.50	1.10	1.60	31.2	2	12,490	50.0	3900	40,085	99
1 1/2	6.00	70	.57	1.25	1.82	31.9	2	15,775	63.0	4914	48,880	104
1 3/4	8.17	60	.66	1.00	1.66	39.7	1	11,676	46.6	3635	28,421	52
2	10.68	55	.73	1.10	1.83	39.8	1	14,027	56.0	4368	32,402	54
2 1/4	13.52	45	.90	1.25	2.15	41.8	1	15,258	61.0	4758	36,384	50
2 1/2	16.69	45	.90	1.50	2.40	37.5	1	16,887	67.5	5265	40,891	55

AVERAGE PRODUCTION PER MONTH (26 DAYS - 3 TURNS PER DAY) 5/8" ϕ TO 1 1/8" INCLUSIVE - 3900 TON
AVERAGE PRODUCTION PER MONTH (26 DAYS - 3 TURNS PER DAY) 1 3/8 ϕ TO 2 1/2" INCLUSIVE - 4800 TON
NOTE:- ABOVE FIGURES ARE BASED ON A REDUCTION OF 1/16" ON DIA.

$P = N(A - a)ST = 2\frac{1}{2}$"

P = PULL ON CHAIN - (LBS.)
N = NUMBER OF BARS PULLED
A = AREA OF BAR BEFORE DRAWING
a = AREA OF BAR AFTER DRAWING
T = TENSILE STRENGTH OF MATERIAL
$2\frac{1}{2}$ = CONSTANT
HP = $\frac{PXF}{33,000}$
F = SPEED OF CHAIN (F.P.M.)

Steel	Tensile Strength	Size Before Draw	Size After Draw	Red. in Area	% Red. Area	"C"	Reqd H.P.	Draw Speed F.P.M.	Pull Actual	Stress P.S.I.	Ave "C"
1018	52000	1/2 x .044	1/2 x .0375	.0058	19.9	3.5	2.71	32	6510	182,000	3.5
1018	52000	1/2 x .125	1/2 x .120	.0438	14.45	3.59	18.5	42	11890	184,200	
1025	60000	1/2 x .080	1/2 x .040	.0263	19.45	3.98	10.79	48	6050	233,00	
NE 8630	90000	1.064 x .140	1/2 x .115	.1449	24.45	3.02	100.9	60	45400	272,000	3.0
1025	60000	1/2 x .062	1/2 x .056	.0273	25.0	2.865	10.79	62	4690	171,900	
4130	90000	1" x .055	3/4 x .042	.0411	25.85	2.44	18.5	50	9380	231,500	2.5
1015	52000	1/2 x .109	1/2 x .083	.1182	30.3	2.57	33.5	58	15790	133,500	
1015	52000	1/2 x .094	1/2 x .078	.1012	28.5	2.02	18.5	67	10630	105,100	
1026	60000	2" x .185	2" x .144	.3701	30.7	1.836	60.3	40	40700	110,000	2.0
1015	52000	1/2 x .125	1/2 x .125	.1354	35.45	2.27	28.6	48	16000	118,100	
1015	52000	1/2 x .161	1/2 x .094	.2242	37.3	1.9	34.9	45	22150	98,700	
1015	52000	1/2 x .161	1/2 x .105	.2234	37.1	1.85	34.9	46	21200	94,900	
4130	90000	1/2 x .062	1/2 x .0375	.0707	41.8	1.11	11.75	45	10500	99,900	1.0
1025	60000	1/2 x .045	1/2 x .035	.0867	48.2	.933	10.79	60	4850	55,900	

NOTE: C = P/A T

Figure 10 — Test data on the drawing of steel tubes.

The value of C must be determined by test data. As indicated before, it is difficult to obtain a consistency in test results, but based upon numerous data accumulated, we have arrived at the following values of C as being suitable in average cases:

Constant	Per cent reduction
3½	15-20
3	20-25
2½	25-30
2	30-40
1	40-50

The reason for the change in the value of C is obvious since at the lower percentages of reduction, the frictional resistance of the die and plug has a greater effect in the total pull required, becoming less as the percentage of reduction increases.

Figure 11 — Showing details of a piece of mild steel tubing that has been push pointed through four successive passes.

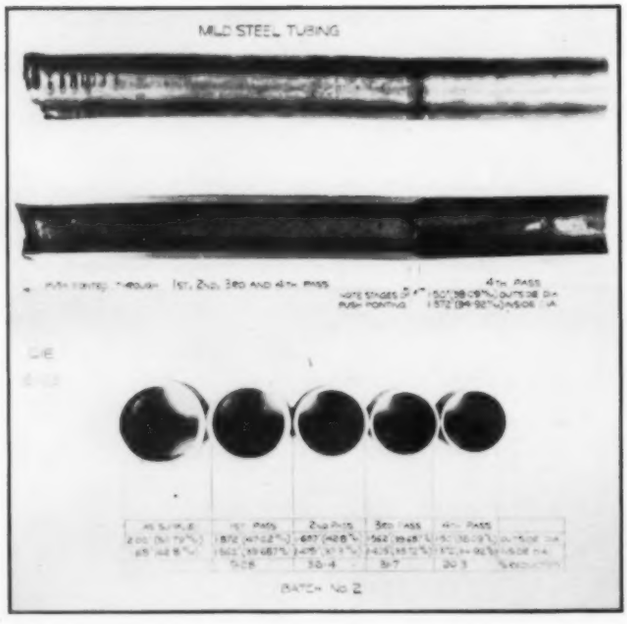


Figure 10 lists certain test data which have been accumulated to substantiate the above C value.

After the pounds pull have been determined, it is a simple matter to determine the motor horsepower output from the formula:

$HP = (P \times fpm) \div (33{,}000 \times \text{mechanical efficiency})$

Bars—Conventional practice is to reduce hot rolled bars after they have been pickled and lubricated by about $\frac{1}{16}$ in. in diameter. Only one cold pass is required to make this reduction.

By experience, the capacity of drawbenches based on mild steel has been established as follows:

Bench rating, lb	Single draw, in.	Double draw, in.	Triple draw, in.
100,000	6	3	1½
50,000	3	1½	1
25,000	1½	¾	½

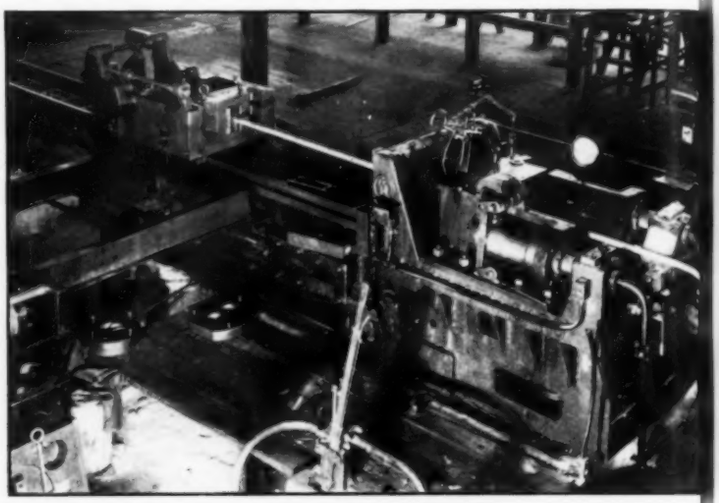


Figure 12 — This 100,000 lb bar bench is equipped with a hydraulic push pointer.

For alloy steel, the size of the bars should be reduced in accordance with the same formula given for tubes: $P = Ar \times T \times C$. In the case of bars it has been found that a value of 2.5 for C will give sufficiently accurate results for most purposes.

DEVELOPMENTS IN ELECTRIC EQUIPMENT

The major improvements in drawbench electric equipment have, like the improvements in the mechanical equipment, been made within the last ten years. Thus, it is possible to find in operation today in this country, drawbenches with electric equipment ranging from the most antiquated to the most modern.

Drawbenches originally were belt driven from an individual power source or from a common line shaft. The first application of electric equipment to an individual drawbench was a single speed a-c motor for driving the main chain, the carriage being returned manually, by gravity, or by counterweight. The next improvement

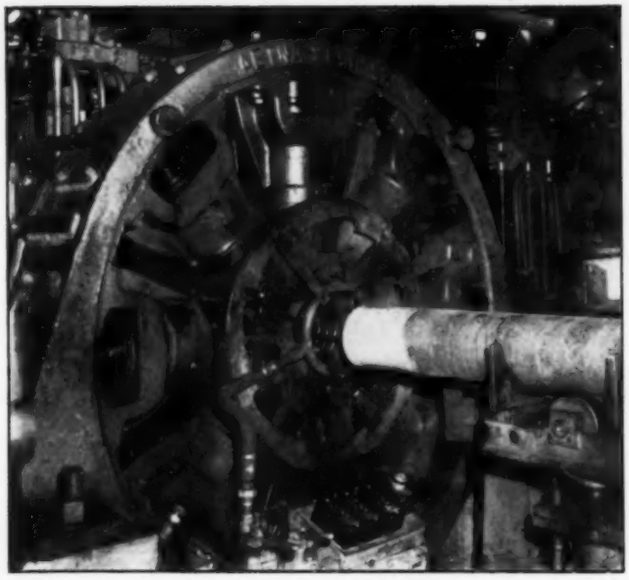


Figure 13 — Typical hydraulic squeeze pointer designed for hot pointing of steel tubes up to 13¾ in. outside diameter x 1¾ in. wall.

was the addition of a carriage return drive which was first accomplished by means of a clutch driven cable drive from the main drive motor. This later was replaced by a carriage return drive having its own motor, which was a significant step in the improvement of overall drawbench operation.

Following the addition of the carriage return drive, gradual improvements have been made, such as the addition of various electrically operated tube and bar handling facilities; along with these improvements has been a gradual improvement in the main drive electric equipment.

The most modern high speed, high production drawbench of today is fitted with an extensive system of electric motors and controls. The higher production rate of the modern drawbench, however, more than justifies the price of the electric equipment required to make it smooth in operation, flexible and automatic.

Electronic applications — Even the drawbench has not escaped the full import of this electronic age. Electronic control has been widely used and with new developments, it is expected that the application of electronics will become even broader. Electronic devices have been used on drawbench control panels for such purposes as: (1) Power supply and control of main or carriage return drive, (2) Forcing and current limit control of deceleration and acceleration of main drive motor, (3) Rectifiers for power supply and (4) other applications such as photo-electric limit switches, load relays, etc.

One of the most promising electronic applications is the use of the electronic control for forcing and current limit control of the main drive. This type of control can be used for the main generator field on variable voltage control, and for the main motor field both on variable voltage control and constant potential control. If an inexpensive control panel can be developed for this application, it will likely be used on all d-c control panels to replace the present methods of field control.

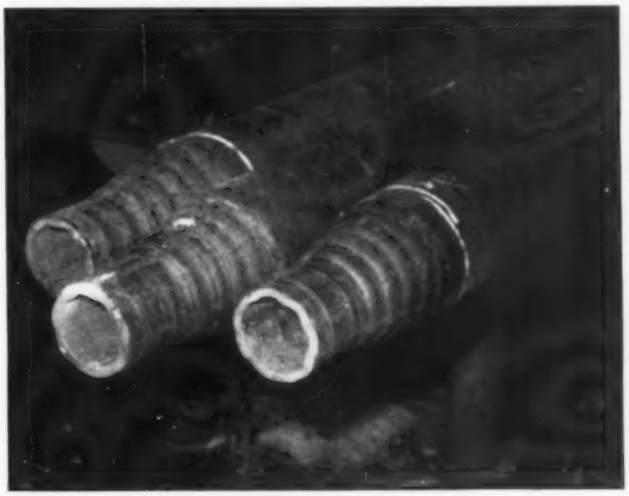
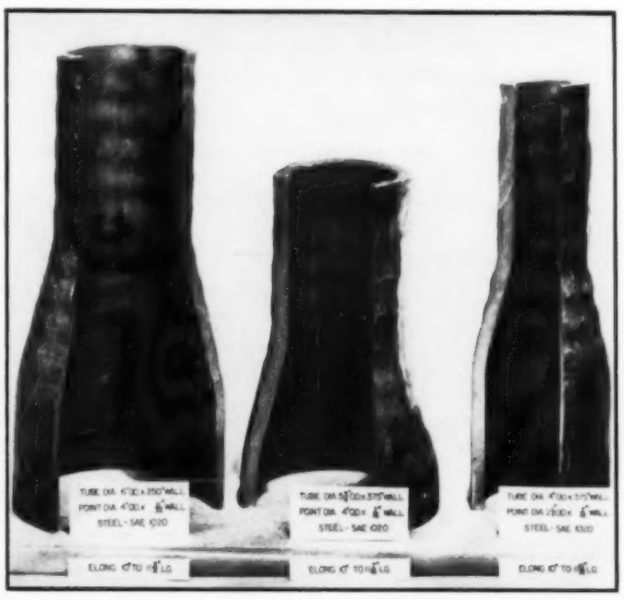


Figure 15 — These 7 in. diameter points were produced on heated 10¾ in. outside diameter steel tubes with hydraulic squeeze pointer.

Figure 14 — Examples of points produced on cold steel tubes with hydraulic squeeze pointer.



Rack and Dual Chain Drawbench Electric Equipment — One of the most modern drawbench main drive electric equipment is that used on the rack type or reversing dual chain drawbenches. In function, the control panels now in use provide every feature available on modern reversing mill main drive control plus the automatic cycle control required for this type of bench.

This current limit controlled adjustable voltage control provides rapid, smooth, controlled acceleration and smooth deceleration. Strong regenerative braking provides the best possible stopping without a magnetic brake in the motor. The unusual performance of this electric equipment makes this rack type or dual chain type bench most interesting to watch in operation.

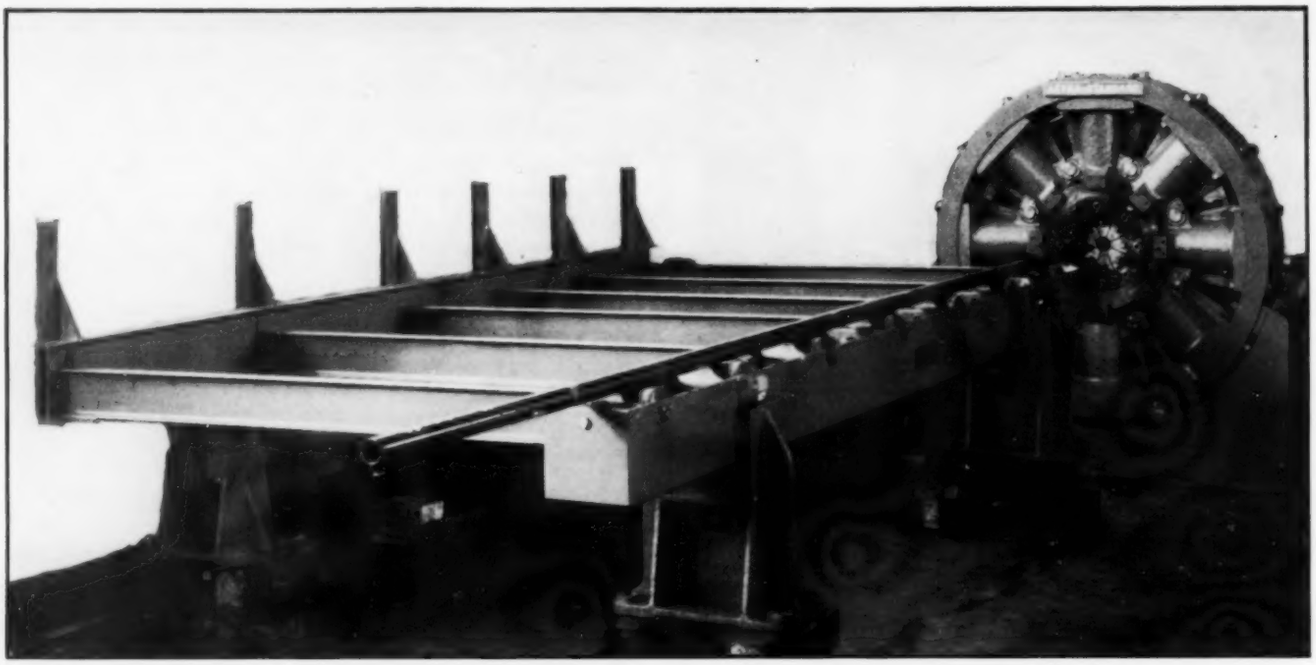


Figure 16 — Newly designed 600-ton hydraulic squeeze pointer with double acting cylinders.

PUSH POINTING OF BARS AND TUBES

Considerable improvement has been made in the design of the push pointer, particularly for benches designed for triple drawing. A new design was developed to provide the following features:

1. Grips of a reasonable length, without serrations, to avoid marking.
2. Independent operation of each pair of grips.
3. Sufficient closing pressure of grips to give positive initial grip without slippage.
4. Easy and quick change of grips.
5. Easy and rapid feed of bars up to die.
6. General accessibility and simplicity of adjustment, and maintenance.

Tube Push Pointing—The ability to push point bars without marking led to the consideration of the push pointing of tubes, and applications for patents were filed in Great Britain, United States and a number of other countries. A considerable amount of research work was undertaken on a 50,000 lb push pointing bench designed for the drawing of single bars and the sinking of heavy walled tubes.

In principle, the tube is passed through the push pointer grips until the end is in contact with the die. The grips are closed and the pusher body moved forward forcing the tube through the die. On completion of the forward stroke, the grips are opened automatically and the plug is pushed by air cylinder and mandrel rod up to the shoulder formed in the tube

As soon as the drawbench carriage grips the tube and moves away from the die, the plug slips into its correct position relative to the die. From this it will be seen that the push pointing operation is one of "sinking." This results in the leading end of the tube becoming thickened at each pass.

Tubes of steel and copper have been push pointed and drawn through six successive passes, with appropriate intermediate anneals, without difficulty. On one test 200 annealed pre-lubricated steel tubes were successfully push pointed and drawn without difficulty. It has been proven that any tube can be push pointed where the reduction in outside diameter is that normally obtained with plug drawing. Round grips are normally used in the carriage and long runs have shown these to be very effective. No internal support is provided during the push pointing operation.

The following advantages are claimed for this equipment for tube push pointing:

1. Elimination of pointing as a separate operation, thus saving space, pointing or swaging machines, labor, and for steel tubes a furnace and fuel.
2. The saving of time. Push pointing is carried out during the return of the carriage and there is no increase in drawing cycle time.
3. The points are strong, thus eliminating point breaks.
4. The points are round, making carriage grip engagement 100 per cent certain.
5. The points are hollow, facilitating annealing and cleaning.
6. The scrap loss is less, due to the consistency of length and shape making the minimum grip length necessary. Two hundred steel tubes were drawn with 1¼ in. maximum carriage grip length. A reduction of scrap is obtained on account of full length cleaning internally.
7. Improved scheduling and flow of tubing through

plant since separate pointing operation is eliminated.

8. In the steel industry where tubes are generally heated for pointing, the greatest savings are possible because of lower capital investment due to elimination of separate pointers and where point heating furnaces, fuel, pointing labor, tube handling labor and facilities can be minimized.

Figure 11 shows a piece of mild steel tubing which has been push pointed through four successive passes. Note the irregular leading end and the number of grip marks, and also the steps at the right hand end of the push pointed portions. Dimensions of this tube are given in the figure.

Recent experience has shown that tube marking can be practically eliminated by use of round grips of rough finished mild steel, not hardened.

Push pointing in the steel industry in this country is, as far as we know, only used on bar benches. These benches range from 25,000 lb up to 100,000 lb, and are normally equipped to push one, two or three bars simultaneously. The largest section now being push pointed on this type of equipment is a 12 in x 2 in. section. The smallest sections being push pointed are $\frac{5}{8}$ in. squares, rounds, and hexagon shapes.

Figure 12 shows a bar bench equipped with a hydraulic push pointer. The push cylinders are located on both sides of the gripping head. Three gripping heads are furnished with this bar bench for single, double and triple draw; they are easily changed by lifting the heads straight up by use of a crane hoist.

HYDRAULIC SQUEEZE POINTERS

Hydraulic squeeze pointers produce reasonably smooth, concentric and hollow points, and will point tubes in such a way that feeding is a comparatively easy and simple job for the operator. They have been used to point tubes up to 16 in. outside diameter maximum, and can be used to make points as small as $\frac{1}{2}$ in. diameter, if required. They are available in three ratings: a 1200-ton, 8-cylinder machine, a 600-ton, 8-cylinder machine, and a 300-ton, 4-cylinder machine. Each design is powered by an individual hydraulic power unit consisting of pump, motor and valves mounted directly on top of the oil reservoir. This unit is not attached to the machine, and can be located to suit conditions.

Figure 13 shows a typical installation of a 600-ton machine which has been used for pointing steel tubes up to $13\frac{3}{4}$ in. outside diameter, $1\frac{3}{4}$ in. wall. These heavier tubes must, of course, be heated before pointing. Many sizes of steel tubes can, however, be pointed cold. Examples of points produced cold on SAE-1020 annealed steel tubes are shown in Figure 14. Figure 15 shows .10 to .20 carbon steel tubes, $10\frac{1}{4}$ in. outside diameter x $\frac{9}{16}$ in. wall hot pointed to 7 in. diameter.

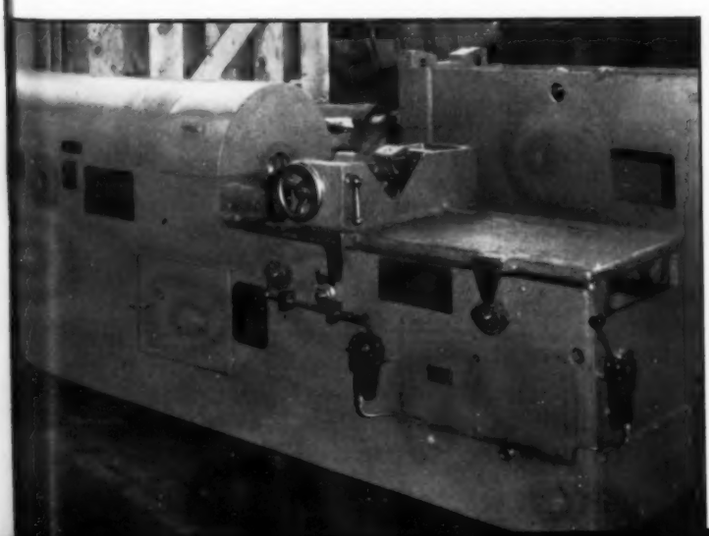
A new type pointer of improved design with double acting cylinders has recently been designed and put into operation. A shop view of this pointer is shown in Figure 16. The rack in the foreground is for storage of tubes before pointing. To make operation easy for the operator the pointer proper is installed in a pit and the table is installed at floor level. This lowers the center line of the pointer to a level best suited for handling and pointing of tubes. The longer cylinder stroke of this pointer combined with the improved action of the double acting cylinders is expected to reduce maintenance costs and provide for better and faster operation.

BAR TURNING POINTER

The bar turning pointer is ideal for rounds, hexagons or square shapes, and fits most logically into the production program where more than one bar bench is used. Figure 17 shows a modern bar turning pointer which is suitable for pointing bars $\frac{1}{2}$ in. to 4 in. in diameter. In operation a bar is placed in gripper jaws and the start control lever is tripped. The jaws close at high speed and the carriage then feeds the bar forward into cutters. The carriage moves rapidly until the bar approaches the cutters at which point its speed is reduced to the cutting feed rate.

When the bar is pointed to the length selected by the operator, it is automatically withdrawn by rapid traverse in approximately one second. Jaws open automatically at the end of the back stroke. The system then remains in neutral until the operator again trips the start control lever. The carriage stops at the same point at the end of each work cycle.

Figure 17 — Bar turning pointer for round, hexagon or square bars, $\frac{1}{2}$ in. to 4 in. diameter.



DISCUSSION

PRESENTED BY

H. GEORGE DeYOUNG, Superintendent of Rolling Mills, Midvale Company, Nicetown, Philadelphia, Pennsylvania

G. W. GARWIG, The Aetna-Standard Engineering Company, Youngstown, Ohio

H. W. POOLE, Application Engineer, General Electric Company, Schenectady, New York

H. George DeYoung: We are primarily interested in the drawing of stainless bars. The only comment I have

to make is that, in any draw bench or drawing equipment, it is imperative that the production department, which is primarily interested in pounds and how many cents it is going to cost per pound, is extremely interested in the type of drawing equipment that is installed in the plant.

I was very much interested in the 60,000 lb drawbench mentioned by the authors, which has a triple draw diestand and a shear. It has been our experience that it is more expensive to draw from coils on that type of bench than it would be on a bull block. We find that in shearing to length compared to drawing from coils, it is more economical to draw in a coil, and straighten and cut afterwards.

G. W. Garwig: In drawing from coils, the size of the stock to be drawn usually determines the machine which should be used. Where both a bar bench and a bull block are available, the bull block would ordinarily be used for smaller stock for the reasons you have indicated. In many cases, however, where there is a wide variety of products with a wide range of sizes but with little production of any one size, the bar bench would likely be the only machine required. It would not pay to purchase both machines when the full output of the bar bench would more than meet requirements. When drawing heavier stock with a bar bench, sufficient power should be provided to permit drawing three bars at high speed. If this is done, considering that three bars are drawn simultaneously, the advantages of the bar bench far outweigh those of the bull block, considering that the bars are straight and sheared to length.

H. George DeYoung: I also have one comment to make about the shear. On the shear furnished with our 60,000 lb bar bench, the blade of the shear runs the full width. The location of the die is fixed; therefore the shearing takes place in one position. It would seem worth while if you could provide an insert which could be placed into the shear so that it would not be necessary to remove an entire shear blade and consequently redress the entire blade since all the wear occurs at one place.

G. W. Garwig: While the shear could be designed with three separate knives, it would be difficult to fit the three separate pieces into the space available and still provide the required strength. There are advantages to the full length shear blade. For instance, it is often easier to handle one large blade than the three short blades, and we feel that there would be little overall advantage for either method of design. Other shears of this type now in operation have proven entirely satisfactory.

H. W. Poole: A few facts concerning the electrical equipment which has been used on these drawbenches may be of interest. The reversing dual chain benches have in all cases been provided with type MD or MDP motors. The peak load capacity, low WR^2, and suitability of these motors for operation at double voltage have contributed to the success of these branches. The rack-type benches have been provided with industrial type motors of special design in order to keep the weight of the motor and the motor WR^2 to a practical minimum. In the case of the rack-type drawbench, the weight of the motor is important since it rides on the carriage.

Adjustable voltage control has become universally acceptable for these benches which must accelerate and reverse frequently. The amplidyne exciter has proved exceptionally satisfactory in providing voltage regulation and current limit acceleration in conjunction with the adjustable voltage generator.

I note that the authors have issued a challenge to the electrical industry by calling for a more economical form of electronic control for the generator field. We are willing to accept this challenge, but it is not likely that the electronic control will have any operating advantages over the amplidyne control which is now used.

The Challenge of the Machine Age

By JOHN E. GOBLE, President
National Tube Company
Pittsburgh, Pennsylvania

▲ IT would be difficult to fix the exact time of the beginning of the so-called "machine age." It is not less than 150 years old and probably considerably older than that. Its effects on society began to appear at least as early as the beginning of the 19th century, when the use of machines began to change modes of life. Before the machine age, the individual was mainly self-sufficient or able to trade his simple skill for the simple skills of others. He comprehended fully the system under which he lived. He was not yet a "cog in the machinery," since there was little or no machinery.

But as machines appeared and multiplied, life rapidly changed, with few persons realizing what was happening. The change was not entirely unnoticed however. For instance, Frederic Le Play, a French engineer, whose professional work in the 19th century took him over most of Europe, began to doubt, as early as the year 1829, that the changes wrought by rapid technical and industrial development were altogether beneficial to various European communities. He noticed that in

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simpler communities, where the chief occupation was agriculture or fishing or some primary activity, there was a stability of the social order that failed to characterize industrial centers, where larger groups were engaged in the use of machines. He pointed out that in the simpler communities the individual understood the various economic and social activities and participated in them. In the industrial communities he found social disorganization, and individual unhappiness.

In the 150 or more years of the machine age, tremendous technological advances have been made. The many separate engineering, physical and chemical sciences have each become huge fields of study. Specialization there has developed to the nth degree. In the United States today there are approximately 300,000 technologists, highly trained in the engineering and other physical and chemical sciences. To the present engineers and those who have gone before mankind owes much for having accomplished great things. Engineers have developed and improved machines and processes, which have, in turn made United States the greatest producer of physical things that the world has ever seen. Accomplishments in the recent war are sufficient evidence in and of themselves to prove this point. Our standard of living, our power as a nation, our productivity as a society, have become entirely dependent upon the use of machines. As machines have become more nearly perfect, as they have become better engineered, our average standard of living has increased and our power as a nation has grown. But the social changes, the changes affecting the individual, brought about by industrial advances, have been enormous and have been permitted to take place without the amount of thought or direction that has accompanied technological progress. Each major new development has magnified our social problem and caused a greater social impact on the individual. We have concentrated tremendous energy and thinking on the physical; we have sought this type of advance with outstanding success, but we have, until fairly recently, given but slight recognition to the human phases of our development. Individuals have been uprooted and confused by industrial development, by the changing and abolition of skills and avocations which have been means of livelihood. They have not understood why various changes have been made that have affected them vitally, although such changes may have been highly beneficial to the community as a whole. I think it is accurate to say that only a small fraction of our energy and thinking has been devoted to the human aspects of the changes that have occurred. This has left the individual with problems with which he could not cope alone. The strategy of cooperation might well have saved his situation, but being insufficiently developed, it has not provided an adequate support. The results have been that political opportunists and group leaders of all types, have preyed upon our progress, upon the individual's inability to understand and solve his own problems. The strategy of antagonism has often prevailed over the strategy of cooperation.

Our human or social difficulties have begun to catch up with us. Although we have the greatest productive capacity in the world, marvelous instruments and machines, highly developed knowledge of chemistry and other detailed, specialized capacities, these are not being used to the greatest extent possible. We have the physical equipment and the knowledge to satisfy enormous pent-up demands, and yet our use of these facilities is impeded by improperly adjusted social factors. It seems that as our machines and knowledge of them have improved, our use of them has become more and more difficult, so that it can truly be said that the challenge of further progress lies not so much in the physical development of machines as in the development of cooperative attitudes in human beings. Since the end of the war in August, 1945, nonuse of machines due to disagreements has cost our country untold billions of dollars of production. We have lost, during this period, 20 million tons of steel, 2 million automobiles, 100,000 tractors, and 135 million tons of coal. This is certainly evidence of a serious fundamental confusion, one that surpasses the problems connected with advancement in the engineering and physical sciences.

Let us explore the nature of this problem. It is a fact that nonuse of machines due to strikes, walkouts and slowdowns has increased because of conflicts of interest between groups within our country. During the past twenty years there has been a remarkable growth of class or group conflict, and it has come about in the face of other developments which would seem to work against class difficulties; for instance, education is much more general today than it has ever been in the past. The Commission on Higher Education last year reported to the President of the United States that enrolled high school students had increased from approximately 11 per cent of the eligible boys and girls in 1900 to 73 per cent in 1940. Similarly in 1900 there were only 250,000 of the population enrolled in colleges, while in 1947 the enrolled number of students had soared to the unprecedented figure of 2,354,000, or nearly ten times what it had been in 1900. This trend is strongly toward equality in education and culture. In the past, higher education was for the most part reserved for children of the well-to-do. Today I believe it is proper to say that we are approaching availability of education to all those whose capacities warrant it, regardless of their financial resources. Yet the conflict between groups has increased regardless of trends in education, which logically should act as a corrective. It has also increased in the face of less antagonism between individuals in our society. Today I believe that men have a substantial degree of respect for each other, regardless of their stations in life. Most men today realize that men's fundamental desires are substantially the same. The laborer, the carpenter, the banker, the plumber, the business executive —each seeks the respect of his family, his associates, and his friends—each takes pride in his work—each wants something better for his children and their children—and each looks with a degree for his children and their children—and each looks with a degree of anxiety at his security—the protection of his family and himself in hard times. There is a growing awareness of the sameness of these fundamental attitudes, yet the struggle of groups continues. Why?

Most of us have at least some idea as to what is wrong. We could dismiss the whole problem of industrial strife by saying that it has been caused by stupid political demagoguery. We could say: "Cure the poli-

tical situation and the problem of industrial strife will take care of itself." We all know that this answer, while true to an extent, is not the complete answer. The problem is deeper than that.

In our rapid and intense industrial growth, individual self-sufficiency has necessarily been sacrificed. While in the past each man provided his own tools and produced what he needed, today we produce for each other instead of directly for ourselves. In this change-over we have lost various fundamental needs with respect to man's individual happiness. One of these is the individual's broad insight into what is going on. As each individual becomes specialized there is a diminishing urge in the course of earning a living to know what other people in other lines of activity are contributing. The knowledge about others diminishes as interest in knowing about them lags. The individual loses sight of the importance of the contributions of others. Specialization makes us entirely dependent upon team play or cooperation and yet tends to decrease our interest in the activities of others, which is a basic factor in cooperation and team play. We have there, I believe, one of the very important seeds of our present discord. The lack of appreciation of the whole, the failure of the individual to develop an awareness of and an understanding of his place in the whole picture, has left him confused. In his confusion he falls easy prey to misdirected group action. We have, in fact, over the last generation had ample evidence of such action by those who seek thereby to serve their own selfish ends in the attainment of power.

As specialization has increased, the human being has more and more assumed the aspect of part of a machine. He has literally been a cog in the machinery. Of course, we all must, to some extent, be considered as cogs in the machinery in order to make our complex society work, but we have to go further and not only take into consideration the difference between men and machines but actually demonstrate by our actions that there is a difference. We have actual scientific facts to work with on this score. We know that man is something above and different from a machine. He is subject to emotional and physiological disturbances. We know that he is interested in more than his pay check. He must find satisfaction in his work and must feel that he is an adequate member of society. He desires recognition and prestige and the opportunity to demonstrate his pride in his home, family and job.

Let us consider an example. We know that the work of the industrial engineer is that of dealing directly with the problem of men and machines. The physical, scientific aspects of the machine's capacity to produce, its arrangement with other machines, the whole process in which the machine is involved, are matters vital to the performance of the work of the industrial engineer. But we know that regardless of soundness of formulae and the mathematical computations, the planning of the industrial engineer is of no value unless human effort is added and that effort results in production. The industrial engineer may create a system of rates of pay to provide incentive for greater effort, but unless the workers who operate the machines fully understand the system, its objectives and its bearing upon their own interests, failure will probably result, because the engineer was not fully alert to the human or social aspects of the problem.

Let us take another example. The physician is a scientist, an engineer, a trained technician, whose duty it is to keep the various parts of the human body cooperating with each other. He is ordinarily called in when one of those parts ceases to function or functions poorly. We all know that if he is a well-trained doctor—and if he has had proper experience—he will not confine his attention to body chemistry and the mechanical phases of his duty. He knows that there is something else necessary in order to have the sick body become well again. There must be the desire, the will or the purpose on the part of the patient to get well. In other words, he must have the cooperation of the patient. And how can such cooperation be secured if the patient knows nothing whatever of his ailment and is not educated by the physician as to how he can contribute toward helping the physician effect a cure? It is true that the human body can be in perfect condition mechanically and chemically and yet be ineffective—ineffective because there is lacking the mental attitude so necessary to provide the desire, the will and the purpose to live and live effectively. The wise, experienced practitioner recognizes this and does something about it. He goes beyond the confines of his technical training.

Some students of our industrial civilization have stated that we are presently living improvidently on our capital—that is, upon the store of human good will which centuries of cooperative living developed and left to us. Some of these same students take the position that if technical and material advance is maintained, human cooperation will somehow inevitably follow. There may be some truth to the claim that we have been living improvidently on our capital of good will, but we cannot proceed on any hit-or-miss theory that if technical and material advance is maintained, human cooperation will somehow follow. Such a line of thought might be largely responsible for our present unhappy situation. The human and social elements involved in the development of the machine age must not be lost sight of in our concentration on technical and material advancement.

You cannot, as specialists, concentrate your efforts alone in the narrow confines of your chosen specialty. You must consider the whole industrial body as well as the segment with which you are particularly concerned. You must realize that the work of the technician has not been completed when he has conceived, designed, built the machines and located the push buttons and levers controlling their operation. The most important job still faces each and everyone of us—the development of our human relations, so that the working arrangement between human beings will keep pace with the physical developments of this machine age. Happily, in many quarters there is a growing appreciation of the importance of this factor. Such appreciation can stand further extension, encouragement, and acceleration. The job cannot be done by a few trained counsellors. It must be shared by each and every individual, so let us accept the inescapable fact that the burden is squarely on the shoulders of every American citizen, on your shoulders and mine.

GEORGE W. NIELSEN
IRMINGHAM DISTRICT SECTION

CHARLES P. HAMMOND
BUFFALO DISTRICT SECTION

RYLAND J. BEESWY
CHICAGO DISTRICT SECTION

AISE DISTRICT CHAIRMEN 1948-1949

GEORGE W. NIELSEN was born in Chicago, Illinois and moved to Alabama at an early age where he attended school. He served as an apprentice machinist for the Fred W. Wolfe Company of Chicago, and after service in World War I, has been continuously in the employ of Tennessee Coal, Iron and Railroad Company. Starting as a machinist, he was made shop foreman, general foreman, assistant master mechanic and at present is mills master mechanic, Fairfield Steel Works.

CHARLES P. HAMMOND was born in Chester County, Pennsylvania where he received his elementary schooling. Further education was obtained through night school at Drexel Institute and Temple University, and other work at Carnegie Institute of Technology, University of Pittsburgh and Columbia University. He joined the Midvale Steel Company organization in 1914. Later he was a roller for Hess Steel Company (now Rustless Iron), and United Alloy, Canton, Ohio (now Republic Steel). In 1925, he joined the Crucible Steel Company organization as roller and was promoted to superintendent of mills, Park Works, Pittsburgh. In 1928, he joined Universal Cyclops, later rejoining the Crucible Steel Company, at Atha Works, in Harrison, New Jersey. He came to Atlas Steels Limited, Welland, Ontario in 1933 and is, at present, superintendent of mills.

RYLAND J. BEESWY started working for the Inland Steel Company as an open hearth motor inspector in 1916. He served in the Navy in World War I. In January 1942 he was promoted to assistant superintendent of the Electric and Power Departments. He assumed his present position of assistant superintendent of Electric, Power and Steam Departments in January, 1947.

GEORGE S. MONKS' experience has been in the drawing rooms of various steel concerns starting during summer vacations with Colorado Fuel & Iron Company in 1902-3. He was employed by Jones and Laughlin Steel Corporation, Eliza Furnaces in 1914 and has been in their employ continuously since. He was appointed resident chief engineer of the Otis Works at Cleveland, Ohio in 1942 when The Otis Steel Company merged with Jones and Laughlin Steel Corporation.

HAROLD F. LESSO has been with the Great Lakes Steel Corporation since 1931. After working through several production departments, he served ten years in the Technical Department. For the last six years he has held the position of open hearth control metallurgist. His formal technical education was taken at the College of the City of Detroit, now Wayne University.

WILLIAM A. SMILEY was born in Dayton, Ohio, and reared in Pennsylvania, where he was first employed as a teacher in the public schools. He later served some years as a cost accountant specializing in business reorganization. A side line as consulting radio engineer was abandoned with the advent of the radio trusts in 1923. The prospect of developing electronic applications in industry induced him to enter steel mill work in 1924, as an electrician with the Bethlehem Steel Company. After some years of research and development work he became electrical engineer at Steelton which position he now holds.

K. L. JOHANNSEN was born in Ricketts, Iowa where he received his elementary schooling. He graduated from Iowa State College, Ames, Iowa with a Bachelor of Science Degree in Electrical Engineering in June 1933. He was employed as a wireman in the Electrical Construction Department of the Gary Sheet and Tin Mills, Carnegie-Illinois Steel Corporation in 1936. In December, 1937 he was transferred to the Irvin Works of the Carnegie-Illinois Steel Corporation as an electrical Inspector Cold Reduction Mills during the construction of the plant. From March 1938 to May 1941 he worked in the Cold Reduction Department with his last position being general maintenance foreman. From 1941 to 1945 he was general maintenance foreman of the 80 in. Hot Strip Mill. In December 1945 he was transferred to Duquesne Works where he was made assistant superintendent of maintenance, and on January 1, 1948 he became superintendent, assigned and operating maintenance, which position he now holds.

GEORGE S. MONKS
LEVELAND DISTRICT SECTION

HAROLD F. LESSO
DETROIT DISTRICT SECTION

WILLIAM A. SMILEY
PHILADELPHIA DISTRICT SECTION

K. L. JOHANNSEN
PITTSBURGH DISTRICT SECTION

FUSETRONS' Time-Lag STOPS Needless SHUT DOWNS ....Holds Harmless Overloads

As shown by this Example

"In 1941 our electrical superintendent and his assistant had test installations of Fusetrons made in many different sections of this plant.

"The spots chosen were those where needless blowing of fuses was causing trouble as on the drawing machines in the rod and nail mills, the 600 ampere main circuit feeding three 50 h.p. cranes, and motors in the open hearth department where ambient temperatures run very high.

"After months of operation, reports on all of these installations were so satisfactory that a complete standardization on Fusetrons for our entire plant was made.

"After over two years of standardization on Fusetrons a report from our general storekeeper showed that replacement cost on Fusetrons was about one-third of the former cost with renewable fuses.

"Naturally, the savings must be far greater due to elimination of production interruptions. Actually, we can probably credit Fusetrons to a large extent for the all-time records we have set since we installed them — because we have had the same plants and equipment that we had had in previous years."

A Large Steel Plant
(Name on Request)

What is the Fusetron?

The Fusetron is Bussmann's dual-element fuse — a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses, Fusetrons fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

BUSS

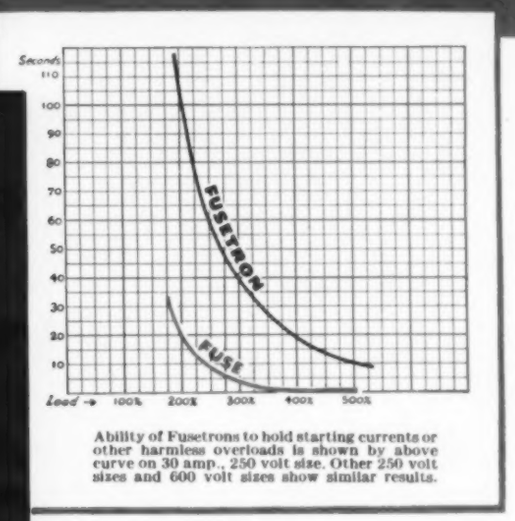
Keep Your Men and Machines on the Job!

With Fusetrons installed throughout your electrical system you will be entirely free of shutdowns caused by fuses blowing on motor-starting currents or other harmless overloads.

It is the time-lag of Fusetrons that does it. For instance: at 300% load a 30 amp. 250 volt Fusetron will hold 39 seconds before opening — yet the ordinary fuse with the longest time-lag will blow in 2/10 seconds. The Fusetron holds 15 times as long.

Other size Fusetrons in both 250 and 600 volt types show similar results . . . yet —

With all this time-lag there is no sacrifice of safety as is assured by the Underwriters' Laboratories inspected label carried by Fusetrons.



Ability of Fusetrons to hold starting currents or other harmless overloads is shown by above curve on 30 amp., 250 volt size. Other 250 volt sizes and 600 volt sizes show similar results.

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The tremendous time-lag of Fusetrons wipes out needless shutdowns so completely that you are able to:

Start all the motors on a circuit at one time — and the Fusetrons won't open.

Have machines momentarily jam or be overloaded — and the Fusetrons won't open.

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Load your circuits nearer to the capacity of your switches and panelboards — and not be penalized by recurring useless shutdowns.

If you want the nearest thing to complete freedom from needless interruptions of electrical service, without in any way sacrificing safety — install Fusetrons throughout your entire electrical system.

Get All the Facts—Find out how it will pay you to install Buss Fusetrons throughout your electrical system.

One needless shut down — or one lost motor — or one destroyed panel, may cost you far more than replacing every fuse with a FUSETRON.

Don't risk such losses — protect yourself by changing over your entire electrical system to FUSETRONS.

Fusetrons GIVE MANY Kinds of Protection Heretofore NOT Available

★ Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.

★ Give Thermal Protection to Panelboards and Switches.

★ Operate cooler because of lesser resistance, thus prevent needless blows caused by heating in panelboards and switches.

★ Permit use of larger motor or adding more motors on circuit WITHOUT installing larger switch or panel.

★ On new installations, PROPER size switches and panels can be used instead of OVERSIZE.

★ Protect small motors against burnout, simply and inexpensively.

★ Give DOUBLE protection to large motors.

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★ Protect coils, transformers and solenoids against burnout.

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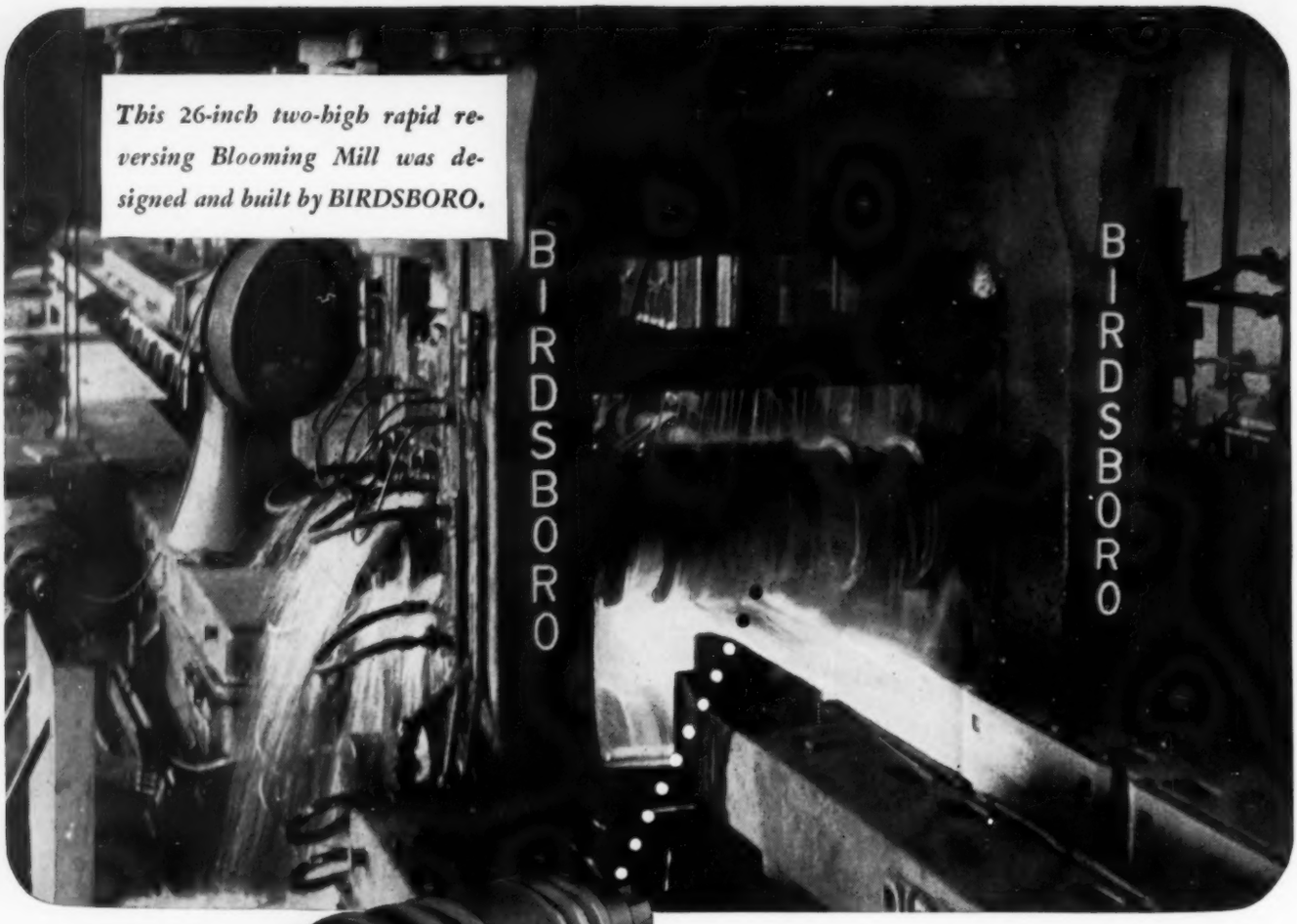

This 26-inch two-high rapid reversing Blooming Mill was designed and built by BIRDSBORO.

The Right Combination
for
INCREASED PRODUCTION
at
LOWER COST

Birdsboro's years of experience in designing and building **ROLLING MILL EQUIPMENT and ROLLS** for practically every conceivable steel producing purpose has resulted in the "know how" that means greater tonnages at low operating and maintenance cost.

MILL EQUIPMENT FOR ALL PURPOSES

Blooming Mills
Merchant Mills
Strip Mills
Structural Mills
Rod and Wire Mills
Sheet Mills
Cold Mills

Furnace Pushers, Tables etc., Bloom, Plate and Bar Shears, Plate Levelers, Gag Presses, Straightening Machines for shapes, rounds and tubes, Flanging Machines for hot flanging and dishing, Special Machinery.

ROLLS FOR ALL PURPOSES

Carbon Steel Rolls
Special Alloy Steel Rolls
Birdsboro Special
Diamondite*
Durite
Birdsboro "50"
Birdsboro "40"
Birdsboro "30"*
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Superloy*
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Curoloy*

FOR: Blooming, Cogging, Roughing, Semi-Finishing Finishing
*Patented

BIRDSBORO STEEL FOUNDRY & MACHINE CO. • BIRDSBORO, PA.

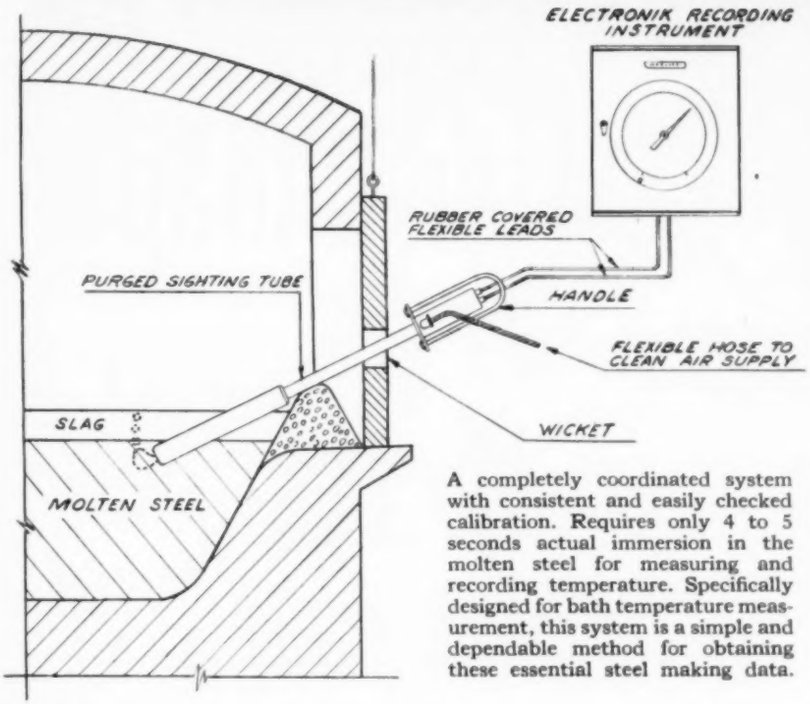
ME—1-48

OFFICES IN: *Birdsboro, Pa. and Pittsburgh, Pa.*

REPRESENTATIVES AT: 332 SOUTH MICHIGAN AVE., CHICAGO 4, ILLINOIS—507 TERMINAL TOWER BLDG., CLEVELAND 13, OHIO

Designers and Builders of: Rolls • Steel Mill Equipment • Hydraulic Presses • Special Machinery • Crushing Machinery • Steel Castings

New PHOTO-ELECTRONIK BATH PYROMETER



A completely coordinated system with consistent and easily checked calibration. Requires only 4 to 5 seconds actual immersion in the molten steel for measuring and recording temperature. Specifically designed for bath temperature measurement, this system is a simple and dependable method for obtaining these essential steel making data.

The ElectroniK Recorder with large expanded scale is designed so that both pointer and pen move only when taking a bath temperature measurement. Thus the pointer continuously indicates the last temperature measured and the chart provides a record of both temperature and the time of reading.

MEASURES MOLTEN STEEL TEMPERATURE

QUICKLY — ACCURATELY — ECONOMICALLY

Improved steel quality, reduction of "Skulls" and "stool stickers," decreased fuel consumption and prolonged furnace life are some of the advantages resulting from measuring steel bath temperatures.

Metal temperature is one of the most important variables affecting steel quality. For a number of years a leading steel corporation has worked within its own organization to modify and perfect the purged tube method of measuring steel bath temperatures. The resulting design makes use of a photo-electric cell mounted at the rear end of a rugged air-purged immersion tube.

A Brown ElectroniK Indicating and Recording Pyrometer of special electrical circuit and design was developed for use with this immersion unit. The combination of instrument and immersion tube design — which is called the Photo-ElectroniK Bath Pyrometer — has now been made available by the Brown Instrument Company to everyone.

For a complete description of this invaluable aid to steel making write for illustrated Bulletin 6.4-4.

THE BROWN INSTRUMENT CO., • 4464 WAYNE AVE., • PHILADELPHIA 44, PA
DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.

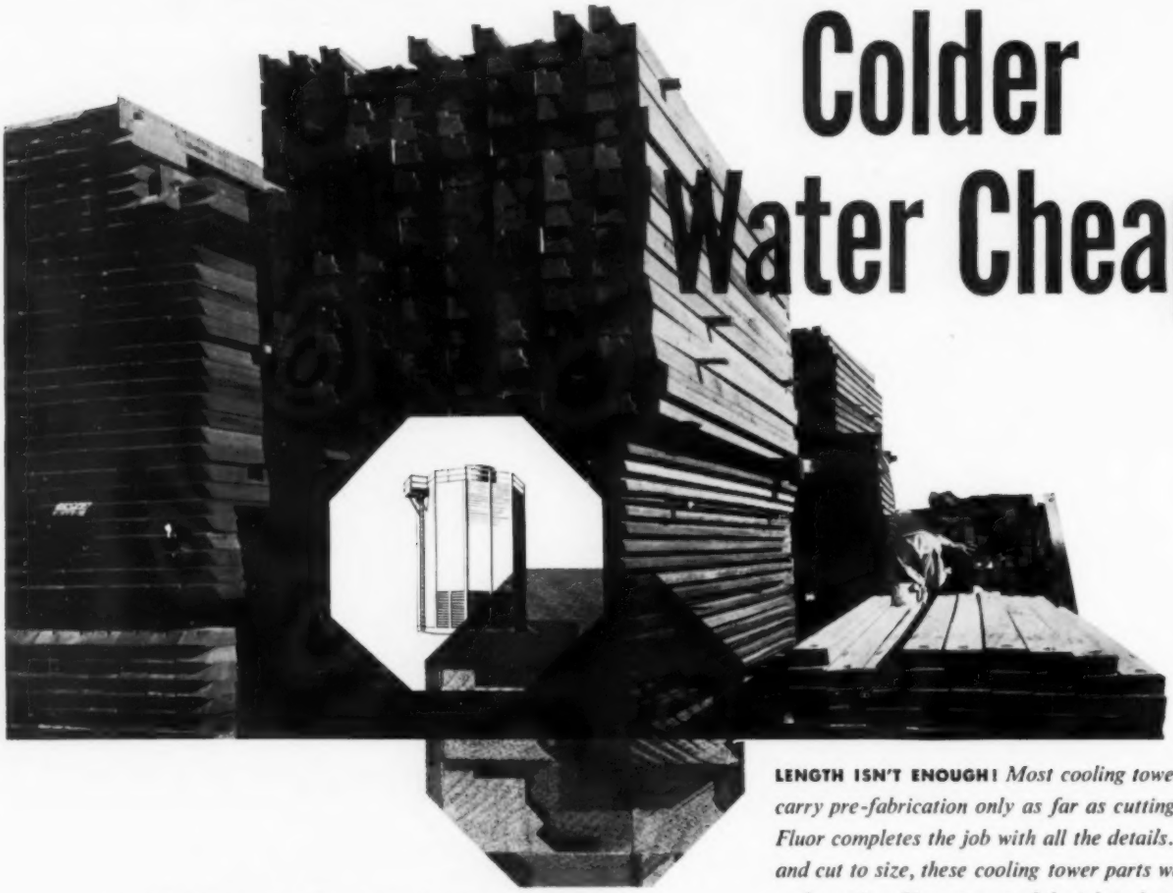
Offices in principal cities of the United States, Canada and throughout the world.

Operator inserting the air-purged immersion tube into the bath. Air flow through the tube provides cooling and prevents admission of molten steel and slag.

BROWN *Advanced Instrumentation* **FOR BETTER PROCESSING**
Product of MINNEAPOLIS Honeywell

PREFABRICATION IN MASS PRODUCTION =

Colder Water Cheaper



LENGTH ISN'T ENOUGH! *Most cooling tower manufacturers carry pre-fabrication only as far as cutting parts to length. Fluor completes the job with all the details. Already shaped and cut to size, these cooling tower parts wait for shipment and erection. Biggest part of the job is done at the mill!*

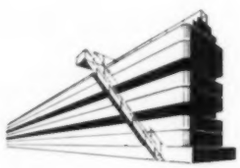
Cheaper? Yes, and here's why...

Only 258 parts for 66 models! Yes, 258 standard, interchangeable, factory-built parts will build any of the 66 Fluor *Counterflo* Models. Manufacture is simpler for us. Parts replacement is easier and cheaper for you.

Quality up, Cost down! Factory precision puts holes in the right places, cuts slots and angles that don't vary. Factory speed cuts costs. Part of savings go into tower improvements, part to customers. Precision tooling and mass production team up to send quality up and prices down.

Delivery now! Not later. Standard assembly-line parts are stock-piled. No lost time in engineering. No special parts to slow production.

40% less erection time! That's what *complete* pre-fabrication means as compared to *partial* pre-fabrication. That's how much faster it is to erect a Fluor *Counterflo* Tower. And... equally important... there is no need to specially train a carpenter-crew for tower building. (Fluor either erects, or supervises erection, of towers... as the customer desires.)



Fluor Aerator atmospheric cooling towers are recommended where this type is the most practical.

The Fluor Fin-Fan cooling unit has a wide, economical range of utility throughout industry.

BE SURE WITH FLUOR

FLUOR

PRODUCTS : *Cooling Equipment, Mufflers, Gas Cleaners, Pulsation Dampeners*

SERVICES : *Designers and Constructors of Refinery, Chemical and Natural Gas Processing Units*

THE FLUOR CORPORATION, LTD., *Los Angeles 22* · NEW YORK · PITTSBURGH · KANSAS CITY · HOUSTON · TULSA · BOSTON

Use them inside or OUTDOORS!

It's all the same to Type WMK
RAINTIGHT and WATERTIGHT*
Enclosed Safety Switch
CONDULETS

**NEMA Types III and IV*

Safety. Positive interlock prevents opening the case unless switch is "off." Dead front switch is held in "off" position while case is open.

Switches. Quick make and break mechanism. Double break, reinforced, positive pressure-type blade and jaw construction. Positive pressure fuse clips. Combination solder or solderless wire lugs.

Cast metal case. Strong and durable. Four sturdy mounting feet. Many possible threaded hub arrangements for both vertical and horizontal conduit. Cover may be padlocked to prevent unauthorized entry. Operating handle may be padlocked "on" or "off."

Permanent lubrication in the threaded operating shaft bearings resists corrosion and prevents the entrance of dust and moisture.

Horsepower ratings. 2 through 50-H.P. 30, 60, 100 or 200-ampere. 230-575-volt A.C. 250-600-volt D.C.

Listed in Condulet Catalog 2500, Section 50, Page 20.

CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

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NORTH AMERICAN
OILTOGAS *Converter**

MAKES IT POSSIBLE
to burn No. 1, 2, or 3 Fuel Oil as a Gas in your present Gas Burners

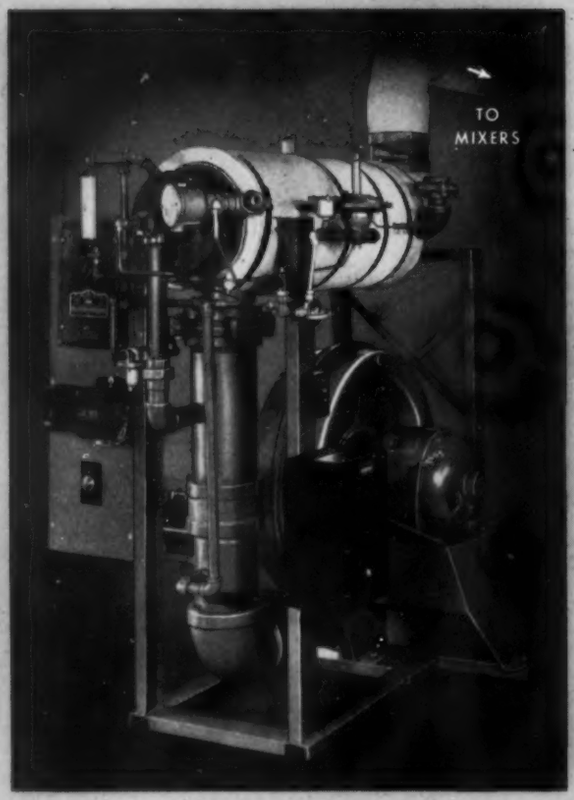


Fig. 1 – Air Heater.

AVOID CRITICAL GAS SHORTAGES

Many industrial ovens, furnaces and boilers are fired with gas burners which do not lend themselves to the substitution of direct oil burners during the trying days of gas curtailments. For such applications North American offers the Oiltogas Converter.

Fig. 2 – Insert Assembly and Mixer.

PRODUCES CLEAN CARBON-FREE GAS FIRES

The principle of the Oiltogas Converter is to supply air at 700°F. to standard North American Aspirator (Gas-Air) Mixers. Into the mixer (through the displacement rod) is injected atomized oil. The hot air immediately vaporizes all of the finely atomized oil and carries the gaseous fuel thus generated to any number of burners.

The air heater shown in Figure 1 is direct oil-fired and is entirely automatic in operation and includes flame safety devices. The amount of fire at the furnace or oven burners is controlled by valves in the hot air line leading to the mixers.

Because of the high air temperatures used and the excellent atomization of the fuel, it is found that even on #3 catalytic fuel oil no carbon or condensate is formed in the piping or burner manifolds. This eliminates the necessity for installing condensate return piping and for periodic cleaning.

*A combination of Standard Combustion Equipment, backed by 30 years of Dependable Service

THE NORTH AMERICAN MANUFACTURING COMPANY

MANUFACTURERS OF INDUSTRIAL FUEL BURNING EQUIPMENT FOR GAS OR OIL

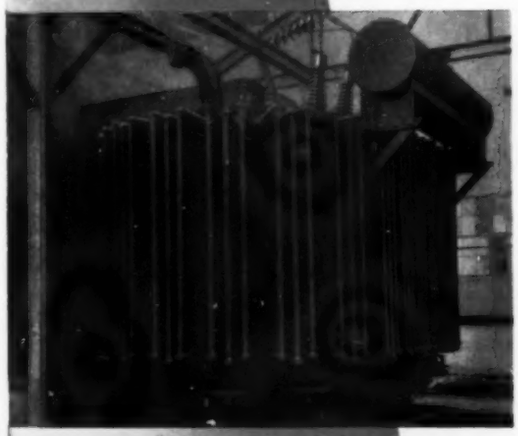
BRANCH OFFICES with FIELD ENGINEERS in PRINCIPAL CITIES

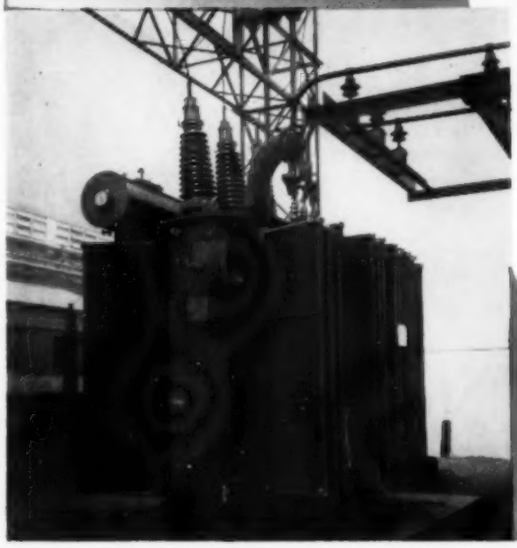
CLEVELAND 5, OHIO

5 Pennsylvania Transformers..126,667 KVA

Pennsylvania TRANSFORMERS

PENNSYLVANIA Transformer Company supplied 5 Power Transformers to Carnegie-Illinois Steel Corporation in the Pittsburgh district at Homestead and Duquesne. Totaling 126,667 Kva, these giant transformers are complete with Pennsylvania's Precompressed Coils, Detachable Uni-Row Radiators and Straight-Line Tap Changers with Silver-Alloy contacts. The fine, rugged construction found in all Pennsylvania Power Transformers is exemplified in these transformers.





In Operation at the Homestead Works

Two 20,000 Kva, OISC, 26,667 OIFAC, 3 Phase, 25 Cycles, 55°C, 44,000 — 6600 volts.

These transformers supply power to:

1. The 100" Semi-continuous Plate Mill
2. The 160" Plate Mill
3. The 45" Slabbing Mill
4. The No. 5 Open Hearth Shop
5. New Armor Plate Department
6. Auxiliary Equipment for the foregoing.

In Operation at the Duquesne Works

Two 25,000 Kva, OISC, 33,333 OIFAC, 3 Phase, 60 Cycles, 55°C, 69,000 — 22,000 volts.

These transformers supply power to:

1. One 70-Ton Electric Furnace
2. Two 35-Ton Electric Furnaces
3. Auxiliary Equipment.

One 5,000 Kva, 6667 Kva with additional radiators, OISC, 3 Phase, 60 Cycles, 55°C, 69,000 23,000 — 6600 volts.

This transformer supplies power to:

1. Four 500 Kw Mercury Arc Rectifiers
2. The Alloy Heat Treating Department
3. Auxiliary equipment for the project.

Pennsylvania
TRANSFORMER COMPANY
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VITAL TOOL FOR *Management!*

Use it to *SPREAD* the national debt!

WITH MANAGEMENT BACKING, PAYROLL SAVINGS PLAN CAN HELP BUSINESS AND NATION

In 19,000 companies, the Payroll Savings Plan (for the regular purchase of U. S. Savings Bonds) has made employees more contented in their jobs—has cut down absenteeism—has even reduced accidents!

In addition, of course, the Plan builds financial security for each participant. Each Bond pays $4 at maturity for every $3 invested.

But the Plan has other, far-reaching benefits—to business and to the nation—which are equally important to you.

SPREADING THE NATIONAL DEBT HELPS SECURE YOUR FUTURE

The future of your business is closely dependent upon the future economy of your country. To a major extent, that future depends upon management of the public debt. Distribution of the debt as widely as possible among the people of the nation will result in the greatest good for all. How that works is clearly and briefly described in the brochure shown at the right. Request your copy—*today*—from your State Director of the Treasury Department's Savings Bonds Division.

WHY EXECUTIVE BACKING IS VITAL

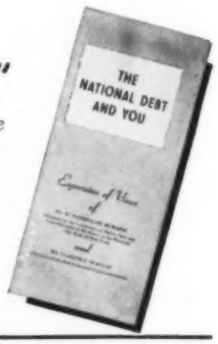
Employees still want the benefits of the Payroll Savings Plan. In fact, they *need* the P. S. P., because banks don't sell Bonds on the "installment plan"—which is the way most workers prefer to buy them. But wartime emotional appeals are gone. Human nature being what it is, the success of the Plan in your company is liable to dwindle unless a responsible executive keeps it *advertised*. The *reasons* for promoting it are as important as ever—to you, your company, and your country.

So—today—*check up* on the status of the Payroll Savings Plan in your company. *Act* on your responsibility to see that it is vigorously maintained.

The State Director will gladly help.

"The National Debt and You,"

a 12-page pocket-size brochure, expresses the views of W. Randolph Burgess, Vice Chairman of the Board of the National City Bank of New York, and Clarence Francis, Chairman of the Board, General Foods Corporation. Request your copy from the Treasury Department's State Director, Savings Bonds Division.



The Treasury Department acknowledges with appreciation the publication of this message by

IRON AND STEEL ENGINEER

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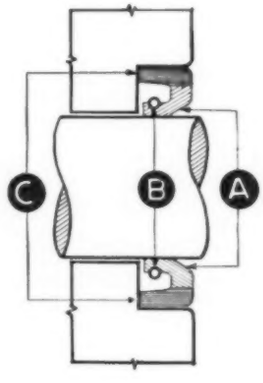
EVER SEE AN OIL SEAL AS SIMPLE AS THIS ONE?



Here's how *Clipper Seal* works:

The flexible lip (A) is held in light but firm contact with the shaft by means of the garter spring (B). Pressure on shaft is carefully pre-determined to minimize wear, yet effectively seal against leakage. The rigid heel (C) provides a press fit in the cavity, assuring a tight lubricant-retaining seal at this point also. This design is readily varied to meet special conditions.

JM

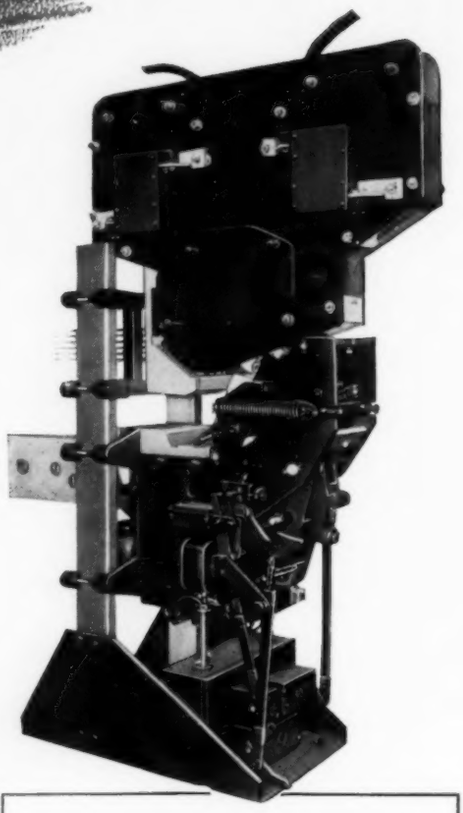
THE JOHNS-MANVILLE CLIPPER SEAL consists of only two parts—a one-piece moulded body and a specially designed garter spring, factory-assembled into a single compact unit.

This simple design, so different in principle, provides advantages not found in most conventional type oil seals. It permits unusual compactness and economy in designing oil seal cavities. It allows greater bore tolerances—since no metal case is used. It offers high corrosion-resistance—since Clipper Seal's body is entirely non-metallic. And it assures positive sealing with efficient, long-term bearing protection in a wide range of industrial oil seal applications.

Clipper Seals are made in both split and endless types and are available for shafts up to 66" in diameter. They are recommended for sealing against oil, grease, water, air, grit and coolants at operating temperatures up to 450° F.

For further information, write for brochure PK-31A. Address Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville **PACKINGS & GASKETS**



Electrical disturbances can't spread trouble with this *more dependable, better built* breaker on the job!

● Short circuits and extremely heavy overcurrents don't have a chance to ruin your essential generators, motors, rectifiers, and connected production equipment—when your electrical distribution system is protected by proper application of I-T-E Type MT Automatic Reclosing Circuit Breakers.

The MT was specially developed by I-T-E—*Switchgear Specialists*—for interrupting extremely heavy direct currents. It breaks a circuit in .028 seconds (about 1¾ cycles on a 60 cycle basis) at 25% to 100% of interrupting capacity. I-T-E's *Rate-of-Current-Rise* Trip anticipates extremely heavy currents—distinguishes between a useful load of high value and a dangerous fault current—and trips the breaker before the danger peak is reached. Shorts and overcurrents are cleared instantly, dependably, before they have a chance to cost you money.

And with the MT breaker, you get an exclusive I-T-E "extra" —*better design* to give you the benefits of manufacturing savings which, in turn, allow higher-quality refinements *at no extra cost*.

Complete details on the I-T-E Type MT Air Circuit Breaker (including Automatic Reclosing Applications) are contained in illustrated catalog 2202. Send for your copy.

TYPE MT—for panel mounting. Single pole, electrically operated. Application: 250 and 750 Volts. Interrupting rating is 150,000 Amp. in continuous ratings 2000 and 4000; 250,000 Amp. in continuous ratings 6000 and above.

ARC EXTINCTION IN THE MT AIR BREAKER

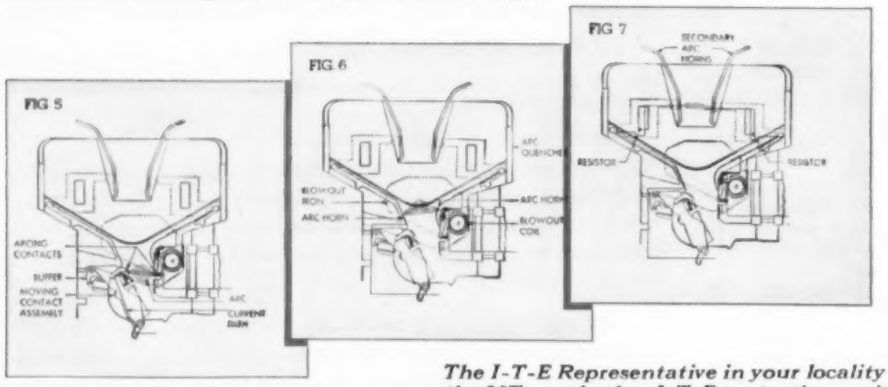


FIG. 5 First stage in circuit interruption: Arc drawn between arcing contacts; blow-out coil in circuit.

FIG. 6 Second stage: Arc transferred to arc horns.

FIG. 7 Final stage: Arc transferred to secondary arc horns; resistors in circuit.

The I-T-E Representative in your locality will be glad to advise you on applying the MT—and other I-T-E protective equipment—to your electrical distribution system. Use his services without obligation.

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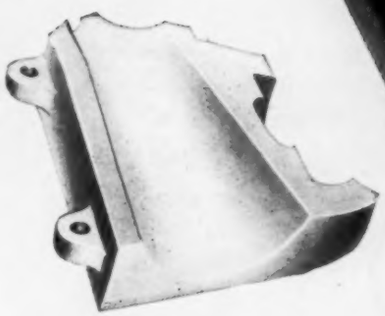
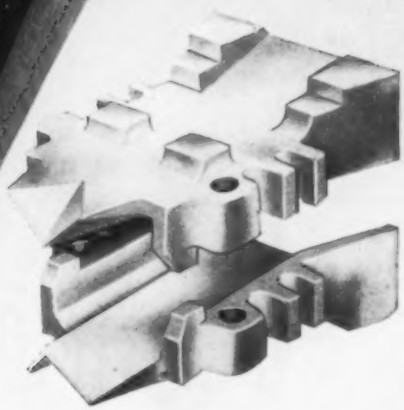
GUIDES THE STEEL INDUSTRY





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80 FIREBRICK

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in severe service

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Today, after 17 years of grueling service—including continuous use under heavy wartime loads and high temperatures—most of the original B&W 80 Firebrick lining is still in service!

If you want to be sure of lower furnace operating costs and increased furnace output, call your local B&W Refractories Engineer. He will be glad to discuss your refractories problems with you.

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B&W 80 FIREBRICK • B&W JUNIOR FIREBRICK
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in a special application of Salem-proved mechanization. Giant "hands" and precision control are here combined to charge and withdraw heavy billets . . . . . smoothly, surely, swiftly . . . . . at the rate of five per minute.

ABOVE: Automatic Billet Charger

RIGHT: Automatic Billet Discharger

These full color photographs, made at the Beaver Falls, Pa. plant of the Babcock and Wilcox Tube Company, clearly illustrate the automatic charging and discharging of heavy steel billets. The mechanisms pictured feed the most up-to-date, precision-controlled automatic heating furnace with unerring accuracy. Working at a rapid rate, the finely adjusted manipulators have put production on a flow-line basis.

Every Salem office has the facts. Address nearest city listed below.

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Salem Engineering Company

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Salem, Ohio *Southwest Office, Fort Worth, Texas*

SALEM ENGINEERING (CANADA) LTD., TORONTO, ONT.
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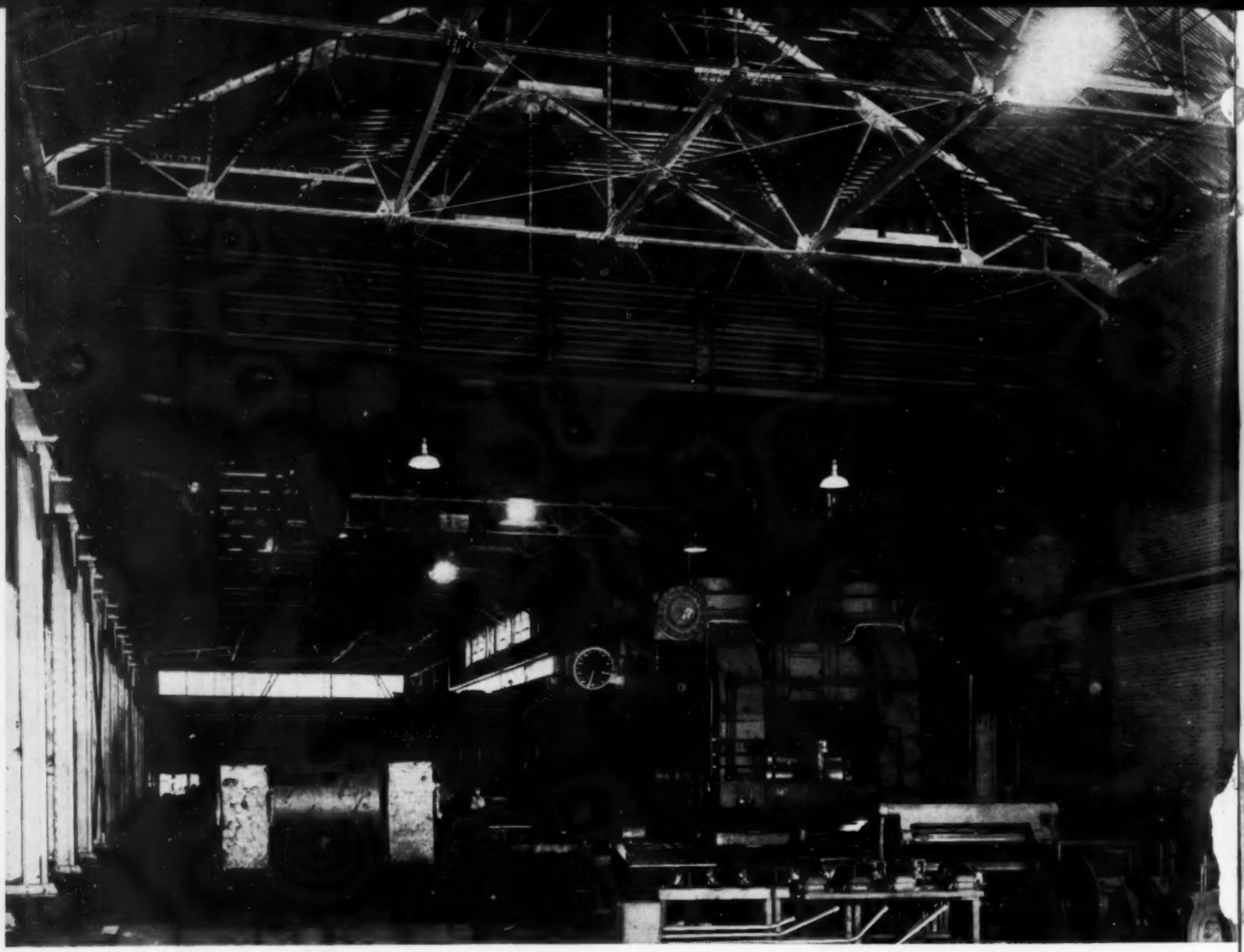

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For rugged dependability, economical lifting power, and long continuous service, you can't top Alliance cranes. That's because they're built by experts . . . designers and engineers who have studied materials handling operations for 50-odd years . . . have developed thousands of cranes to handle all types of loads.

Alliance cranes keep heavy industry on the move—help plants maintain smooth-flowing production schedules week in and week out. If it's economical, dependable lifting power you want, let Alliance—World's Largest Builder of the World's Largest Cranes—develop the equipment best suited to your company's operations.

THE ALLIANCE MACHINE COMPANY

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Alliance

Wire it

WITH DELTABESTON*

When busy motors won't permit "cooling off" periods, where motor overloading is unavoidable, where motors can't escape high ambient temperatures, wind them with Deltabeston magnet wire. Heat-beating Deltabeston is built to "take it" in places where temperatures are really hot.

The specially impregnated-asbestos or varnished-glass-yarn insulations of Deltabeston magnet wires won't bake out. Both types of insulation are bonded to the soft-copper conductor by a special heat-resistant insulating varnish that provides a perfect bond between the copper and the insulation. The copper exceeds the accepted standards of ASTM for purity, conductivity, and temper. Tough, flexible Deltabeston magnet wire—in round, square, or rectangular cross-section—meets your needs for the most intricate winding applications.

But get the whole Deltabeston story! We've compiled it in an interesting booklet that includes a handy table to simplify selection. For your free copy, just fill in and mail the coupon below.

*TRADE-MARK REG. U.S. PAT. OFF.

GENERAL ELECTRIC

HI-AMBIENTS

Application hints on the complete Deltabeston Line

POWER CABLES—The complete Deltabeston line gives you a full range of power cables for applications up to 5000 volts. In lead sheath—with black-finished asbestos braid—or in lead sheath and interlocked armor, all types have the famous felted-asbestos insulation for long service at continued high heats. Choose the power cable you need from the Deltabeston line for resistance to flame, heat, moisture, oil, vapors, or grease.

FIXTURE WIRES—Fluorescent and incandescent fixture installations need the heat protection of Deltabeston Type AF fixture wire. Use it to keep lighting systems in service; to cut maintenance to a new low. You'll like Deltabeston Type AF fixture wire for its workability, too. It's flexible and easy to strip, clean to work with. Ask your General Electric merchandise distributor for samples.

BOILER-ROOM WIRE—Exposed wiring, in installations where heat and moisture are a constant threat, calls for Deltabeston boiler-room wire. It's built for copper temperatures up to 125 C (257 F). It's built to resist heat, flames, and grease. Specify it by name—Deltabeston boiler-room wire—for extra heat protection.

ELECTRIC STOVE WIRE—For wiring or rewiring electric stoves, your best bet is Deltabeston electric stove wire. Smokeless and moisture-resistant types take the day-in, day-out beating of continued heat. For more information, write to Section Y29-1027, Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut, and ask us for the free booklet, *Deltabeston Wires and Cords.*

DELTABESTON
Wires and Cables
built to beat the heat

Section Y29-1046
Construction Materials Department
General Electric Company, Bridgeport 2, Conn.

Please send me the free booklet on heat-beating Deltabeston magnet wires.

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1948 AISE ANNUAL CONVENTION AND IRON AND STEEL EXPOSITION . . . HIGHLIGHTS

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Record attendance and a new high in interest combined to make the 1948 Annual Convention and IRON AND STEEL EXPOSITION of the Association of Iron and Steel Engineers the most successful ever held. The exposition and technical meetings were held in Cleveland Public Auditorium, Cleveland, Ohio, September 28 through October 1. Streamlined registration facilities (1) aided in processing the thousands of steel men without delay. The steel show (2) had 137 exhibitors utilizing 267 booths — another record. In the technical sessions (3) 39 papers were presented by 43 authors.

Each morning authors and chairmen gathered for a breakfast meeting at 7:45 a.m., where the day's activities were scheduled. A typical group (4) shows participants of the mechanical session on Wednesday which included R. L. Rectenwald, Tell Berna, P. L. Walter, F. S. Eckhardt, and George H. Dann.

The Old Timers of the AISE held a get-together party in the Assembly Room of the Hotel Hollenden (official programs to the contrary!). Eleven past presidents of the AISE (5) were seen at the affair.

Typical of the interest in the various exhibits was this scene in front of one of the booths (6).

The steel men from the south came in a large body. Some of the men from Dixie are shown outside the Public Auditorium (7).

One point of interest was a 7000 lb carbon block which is being shown (8) to Walter Nielsen, left, of Sloss-Sheffield Steel Corporation and J. L. Tatman, right, of Wheeling Steel Corporation.

Visitors to the exhibits and meetings included steel men from all over the world. Seen in the exposition (9) were P. K. Chatterjee and S. K. Kar of Tata Iron

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and Steel Company, Ltd., Jamshedpur, India, with W. R. Van Nostrand.

J. F. Black, AISE treasurer and I. N. Tull, AISE secretary, (10) are signing the 1947 AISE Kelly Awards which went to A. J. Fisher, E. T. W. Bailey, and Ross Beynon.

The climax of the Convention was the presentation (11) of a portrait of James Farrington, founder of the AISE. The portrait was donated by Paul Caldwell and was painted by his son William Caldwell. The portrait will hang in the AISE national headquarters.

J. E. Goble, president of National Tube Company, spoke at the banquet on "The Challenge of the Machine Age." He is shown (12) with John L. Young, left, and A. S. Glossbrenner, right.

C. H. Williams, (13) chief engineer, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania, was elected president of the AISE for 1949.

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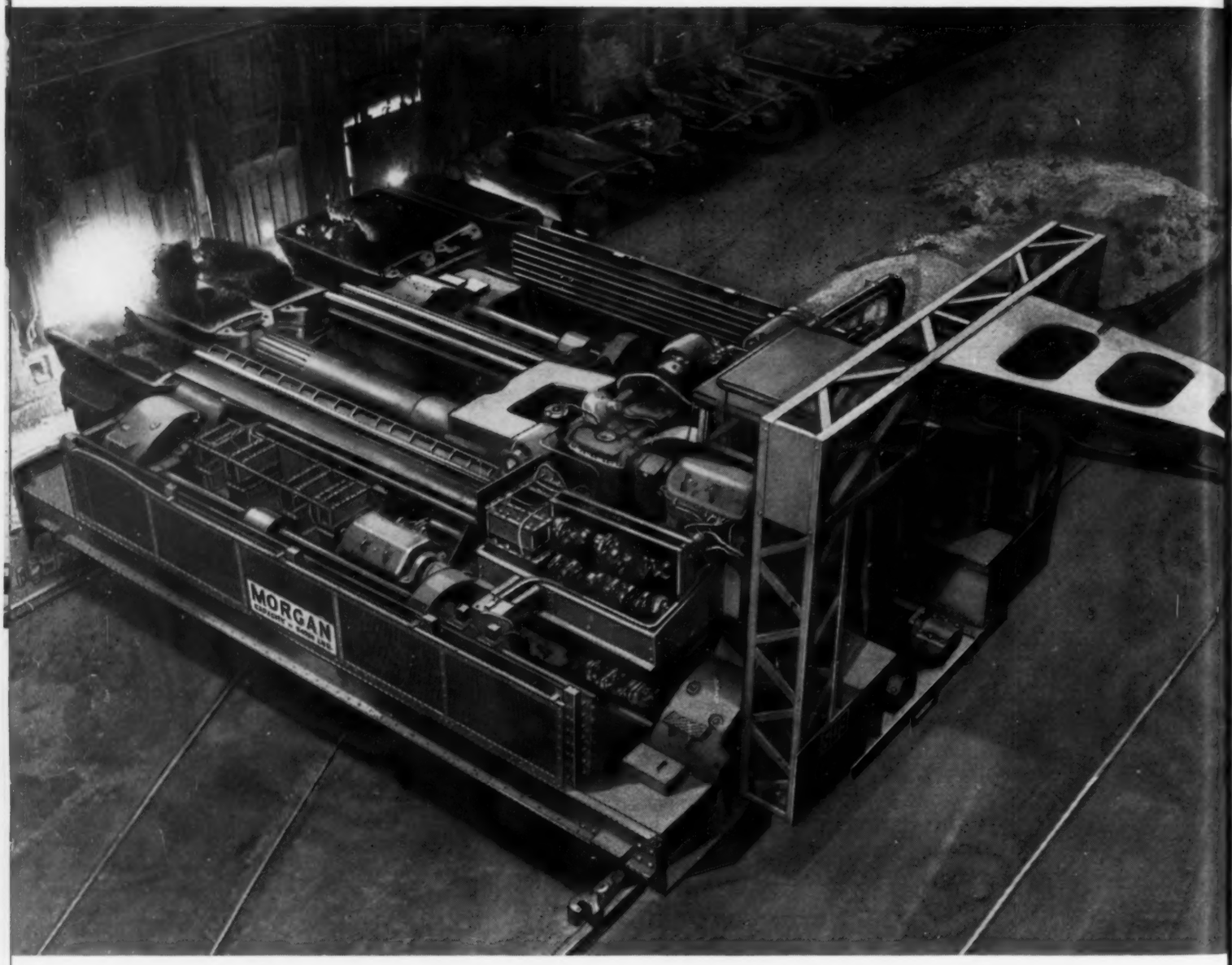
BUILT BY MORGAN Engineering

MORGAN 12-TON LOW TYPE OPEN HEARTH FLOOR CHARGER



Illustrated is one of three Morgan 12-ton 27′-0″ span Box Chargers on this open hearth floor. Trolley frame is a one piece steel casting. Girders are of heavy box section. End carriages are of fabricated welded box construction. Roller bearings are used throughout. Entire machine is of massive construction especially designed for taking heavy thrust loads. Morgan Chargers are built in a wide variety of sizes in both the low and high type to meet varied charging floor requirements.

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NEWS SUPPLEMENT OCTOBER, 1948

Equipment
Personnel
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Iron AND Steel ENGINEER

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CONTINUOUS CASTING OF SEMI-FINISHED STEEL CAN INCREASE AND DECENTRALIZE PRODUCTION

▲ The dream of inventors for a century that steel might be made from the liquid phase to semi-finished shape in one simple, relatively inexpensive machine has become a reality through a joint development of Republic Steel Corporation and Babcock and Wilcox Tube Company.

The results demonstrated in continuous casting of semi-finished steel are said to open up possibilities of utmost importance to the entire steel industry through increasing productivity and decentralizing production by simplification of apparatus and increasing the final yield of steel from the original melt. The new method and apparatus are considered a timely response to great economic pressure to serve areas locally. Interest in the possibilities of continuously cast semi-finished steel is enhanced by current uneasiness over high break-even points and the doubled and tripled cost of new productive facilities.

The greatest single advantage of this process is that it removes from the conventional process of steelmaking the most massive and expensive parts of such plants, such as equipment for ingots, soaking pits, and the blooming mill. Instead, continuous casting permits passing directly from the melt to semi-finished sections ready for secondary mills with the result that not only is the capital cost for a given output greatly reduced, but also maintenance and operational costs. The work accomplished to date makes it clear that for the production of relatively small quantities of steel and particularly as a means of decentralizing steel production, this new development exactly fills the requirements of low capital and low operational costs.

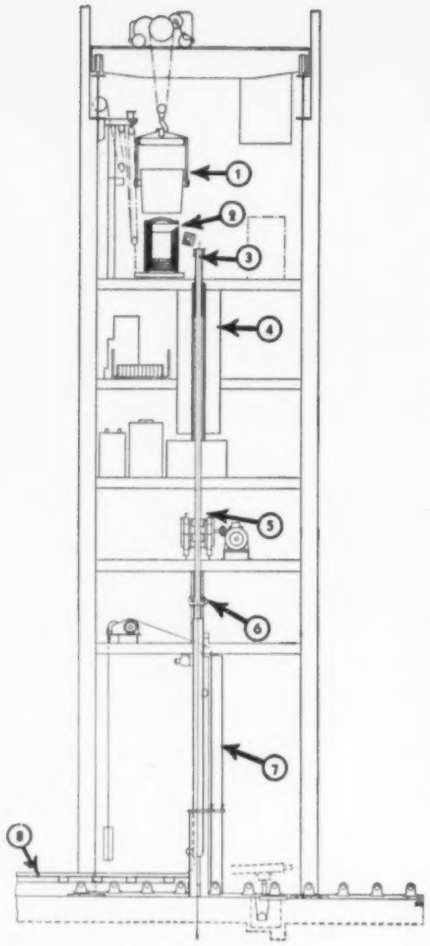
About six years ago, Republic Steel Corporation attacked the problem of continuous casting of steel, and in 1944 entered into discussions with Babcock and Wilcox Tube Company. A formal agreement was made between the two companies in 1946. The work, which started at Republic's plant in Cleveland, was transferred first to the Babcock and Wilcox plant at Barberton, Ohio, and later to Babcock and Wilcox Tube Company's plant at Beaver Falls, Pennsylvania.

For several years the participants in this development have been casting experimental runs of carbon and alloy steel billets. In March of this year, the first continuously cast steel for conversion into commercial products was made at Beaver Falls. Forty-five tons of 0.15 C steel was shipped to a commercial user.

More recently, continuously cast slabs have been rolled into strip. This strip has been converted to electric-welded boiler tubes meeting all of the physical requirements of the company's regular product.

Although continuous casting of

Molten steel is poured, at the top of the furnace, from the transfer ladle into an induction furnace, from which it is poured into a tundish designed to strain out the slag.



A cross-section of the 75 ft tower shows: (1) is the transfer ladle, which delivers the molten steel to an electric induction furnace (2). The furnace tilts to pour the steel into a tundish, where the slag is skimmed off as the steel passes through on its way to the water-cooled mold (3). The now solid, but still hot, billet next passes through an insulated chamber (4), designed to arrest and control the cooling of the billet. Pinch rolls (5) control the billet's speed of travel, and an automatic acetylene torch (6) cuts specified lengths as the billet goes by. The piece, now cut from the continuous casting, is lowered by a cradle (7) from the vertical to a horizontal position, deposited on a roller table (8), and conveyed away to make room for the next length cut. (Courtesy of IRON AGE).

non-ferrous metals has been routine industrial practice for the past 10 years, when attempts were made to apply the process to steel, the problems were multiplied. The metal temperature is far higher and the erosion, segregation, slag inclusion and safety factors are constantly present and very troublesome.

The Beaver Falls unit casts two or three times per week, handling both carbon and alloy steels. A section of about 30 sq in. has been used in this work and is satisfactory for commercial use at a rate of 400 lb a minute. It is expected that continued work on this section will add considerably to the rate. A mold for cross-section of about 45 sq in. is now under construction.

This unit is located at the top of a 75-ft tower to which steel is delivered from the company's regular electric furnaces, and is lifted to the top of the tower in a transfer ladle. There it is poured into an inductively heated holding and pouring ladle.

By watching the liquid steel in the mold by a mirror arrangement, the operators can see at all times whether the liquid surface is clean and the process functioning properly.

Shortly after the shell of the billet has been formed, the steel contracts and in so doing the billet shrinks away from the mold. The metal, therefore, is in contact with the surface of the mold for only a few inches, and only in this short distance can it lose heat to the mold by direct contact.

Proper cooling of the mold is essential and its importance increases as the casting rate is raised. The more rapid the casting rate, the greater the quantity of heat which must be absorbed by the surface of the mold.

Since continuous casting requires a slag-free steel, the steel is poured from the holding furnace into a tundish, designed to strain out the slag. From the tundish the steel flows into the mold. A pre-heated tundish has been used, but a specially designed electrically heated one will be installed.

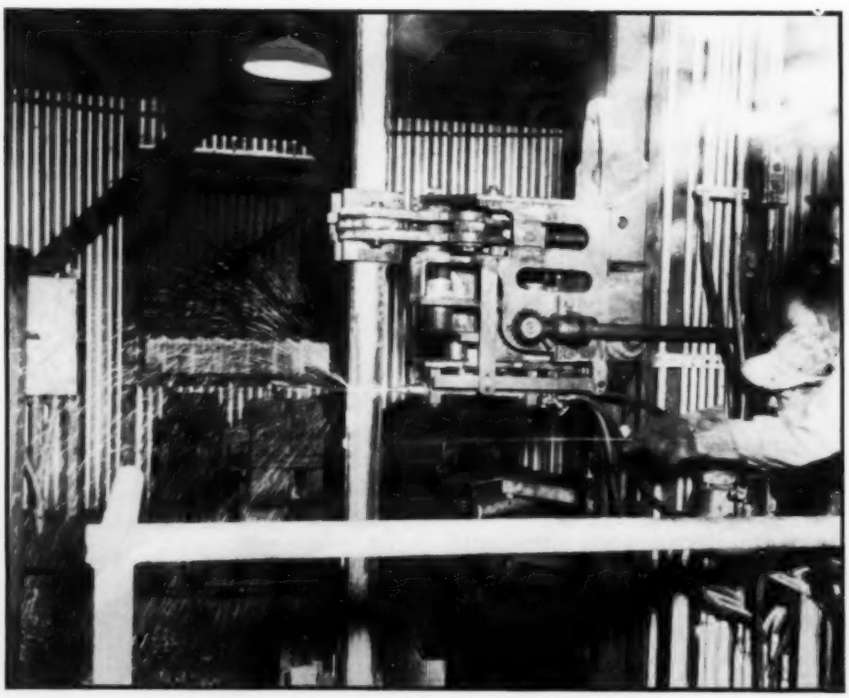
Below the mold, the casting passes through an insulated chamber which arrests and controls the speed of further cooling.

Below this chamber is the withdrawal mechanism regulating the speed of movement of the steel billet. The casting then passes an oxyacetylene torch which travels down the billet a short distance while the billet is being cut to specified length which can be as much as 35 ft. The cut-off section of billet is lowered to a horizontal position by a cradle arrangement.

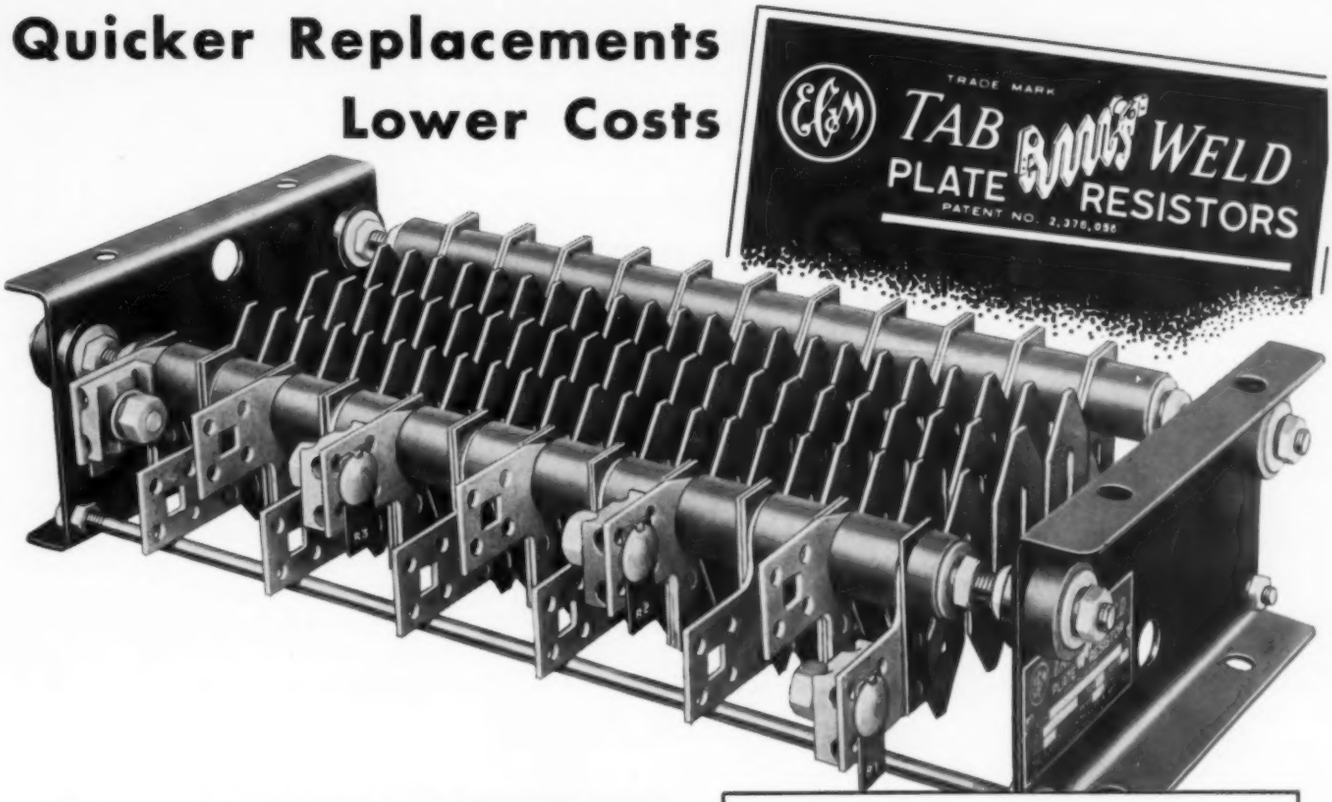
Results at Beaver Falls have indicated that ovals of special proportions are the most practicable cross-section to continuously cast. These ovals will readily go into a rolling mill for shaping into rounds, or can be rolled into flats.

Continuous casting meets fully established criteria of sound steel making practice and has certain advantages over the conventional meth-

The billet moves into a cradle below the pinch rolls. An oxyacetylene torch cuts the casting to the desired length, when the lower end reaches the bottom of the cradle.



Quicker Replacements Lower Costs



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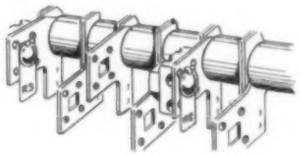
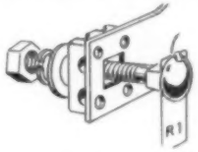
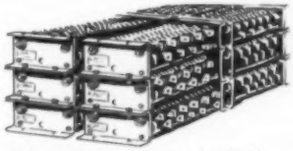


2—Terminal blocks with metal identification tag affixed to terminal bolts.



3—Uniform end - frame mounting hole dimensions for ease of stacking.



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od. It allows faster cooling, which results in a fine and uniform crystalline structure with very little segregation. It offers less opportunity for dirt or other foreign material to enter the castings and, in general, the surface or the ingot will be freer of checking and scabs, and its interior free of entrapped slag.

Flexibility of the heat withdrawal pattern means that it is easier to solidify the steel in the mold progressively from the bottom to the top. Although the mold is of uniform cross-section, it approximates in behavior the big-end up mold—the type used for the best quality steels.

Ingots made by this method are cooled quickly and therefore tend toward a fine grain rather than columnar structure. The billets may be as long as desired and have no taper.

WELDING ROD REPAIRS DEFECTS QUICKLY

▲ If you have hard-to-place worn machine parts, in cast iron or any kind of steel—no matter how hard the part is working—you can now save it at little expense and without any special equipment or skill. The new eutechrom, superhard, low heat welding rod is specifically designed as a universal rod to overlay worn or defective parts on machinery and equipment.

In just a few minutes, it is possible to repair a breakdown due to a part which is worn out through friction, shock, pounding pressure, sand, stone, corrosion or through cutting. Thousands of parts which are replaceable only at great expense, can now be salvaged by your own personnel, without the loss of time waiting for replacements.

The new process consists of using the new eutechrom 2, an electrode coated with a special frigidarc coating which permits the use of the lowest possible current, thus cutting down the amount of heat required and minimizing the risks of distortion, warping, and cracking.

A free sample package of low heat eutechrom 2 is available for thirty days from date of this publication, in six rods of the 1/8 in. size.

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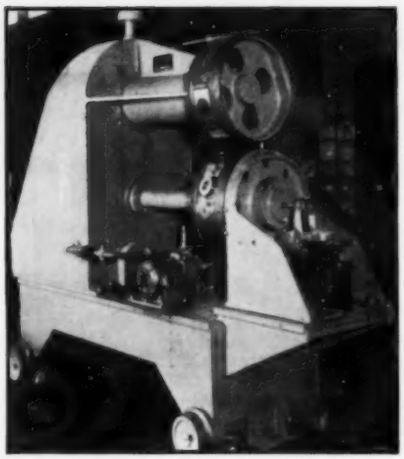
PUNCH CUTS STEEL AT 2000 FPM SPEED

▲ A recently built "United" drum type sample punch has been designed to cut samples up to 4 in. in diameter out of steel strip 0.005 to 0.020 in. thick, running at speeds up to 2000 fpm. Similar machines are now in the design stage to cut samples from strip up to 0.036 in. thick and at speeds approaching 4000 fpm.

Applications for this flying punch are to be found in cold mills, particularly skin pass mills, and processing lines such as electrolytic tinning lines. Samples taken on the fly are to be used for the rapid determination of physical properties and coating characteristics so that proper adjustments and compensations in the rolling and processing operations may be quickly made.

The flying sample punch consists essentially of two geared drums driven by a d-c motor, powered from the Ward Leonard system of the mill so that the punch is at all times exactly synchronized with the movement of the strip. The upper drum has a fixed die and the lower drum a moveable punch, which can be extended by means of a solenoid acting through a toggle linkage inside of the drum. When the actuating button is pushed at the will of the operator, a sequence of operations is set in motion which controls the extension and retraction of the punch, so that only



Applications of this punch are to be found in cold mills.

one sample is cut out even at the highest speeds.

The machine may be made retractable so that samples may be taken at any point across the width of the strip, or fixed—as desired. After the sample is cut it is ejected from the die by a rubber ejector block, and is caught in a retriever scoop, from which the sample is extracted at the leisure of the operator—without in any way interfering with normal line operation.

JACK SELECTION CAN REDUCE OPERATING COSTS

By F. H. SCHWERIN, Chief Engineer, The Duff-Norton Manufacturing Company

▲ There is a wide variance in the cost of jacking loads, depending entirely on the kind of jacks used, rack jacks, screw jacks, or air operated power jacks.

In the present period of high wage rates, the operation of jacking can be quite costly, as will be shown in the following analysis. Jacking loads on which normally 20-ton jacks are required, and if two rack jacks are used near their capacity, two men operating each jack at four strokes per minute, the load will be raised 1¼ in. Then, to raise the load 8 in. would require $8/1.25 = 6.4$ minutes, and with two men per jack, we have $4 \times 6.4 = 25.6$ man minutes to raise the load, and the same for lowering, or a total of 51.2 man minutes. This at a wage of 1.20 per hour equals 0.02 per minute, resulting in a cost of $51.2 \times 0.02 = 1.024$ cost of jacking operation.

Using two screw jacks of the self-lowering type on this load, one man per jack, able to make six strokes per minute will raise the load 0.702 in., and the 8-in. raise will then be made in $8/0.702 = 11.4$ minutes and for two men equals $2 \times 11.4 = 22.8$ man minutes for raising the load 8 in., plus two man minutes for lowering or a total time for jacking of 24.8 man minutes, costing $0.02 \times 24.8 = 49.6$ for the jacking operation with this type of jack, indicating over 100 per cent saving over the rack type of jack.

If we now consider this load being raised with two air power jacks, and both jacks connected with the hose and "Y" valve assembly, one man can operate both the jacks, resulting in the following jacking costs.

Air power jacks will raise this load at a rate of 6.2 in. per minute or $8/62 = 1.29$ minutes for 8 in., and 1.29 minutes to lower or a total of 2.58 man minutes. This time will cost $2.58 \times 0.02 = 0.0516$. These jacks each use approximately 90 ft of air per minute, at a cost of 0.05 per thousand equals $2 \times 2.58 \times 90 \times 0.05/1000 = 0.023$ cost of air used, this added to the jacking

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cost equals 0.0516 plus 0.023 = 0.0746 say 7½ cents cost of the total operation, showing a considerable saving over either of the former two methods, also without the operator fatigue, resulting from hand operation, especially with the rack jacks. Therefore, additional savings result by use of air power jacks in that the operator can proceed at once with the repair work, no rest period being required. Therefore, by the use of air power jacks, the overall savings in labor costs would in a short time pay for the price of air power jacks.

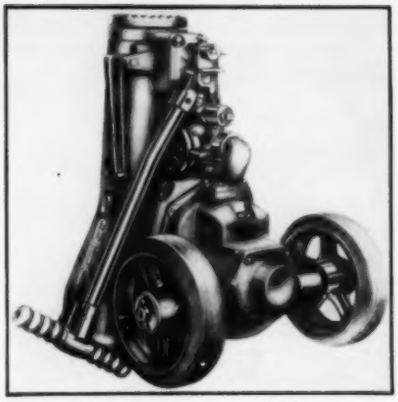
Total cost of jacking only, 20 ton jacks:

Total cost of jacking 8 in. with rack jacks, 1.02.

Total cost of jacking 8 in. with self-lowering screw jacks, 0.50.

Total cost of jacking 8 in. with air power jacks, 0.07.

In all of these studies, the time used for hand operated jacks was considered as the best that could be obtained by continuous operation of the jacks, no rest periods, so that the actual total time of jacking may easily be doubled and consequently the cost of jacking with hand operated jacks would be considerable over the figures used in these comparisons.



Proper use of jacks can reduce the cost of the operations.

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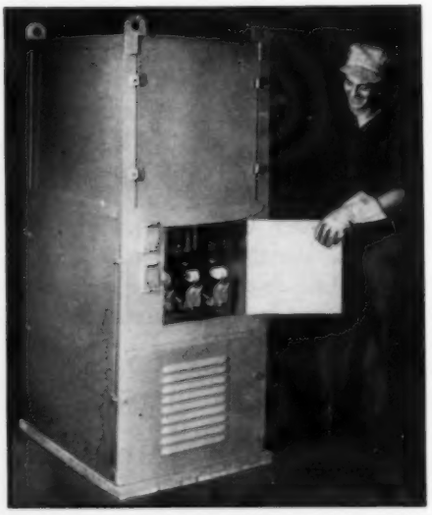
MEDIUM-SIZED COOLER FOR SMALL PLANTS

▲ A small air conditioning unit designed to protect crane operators against the hazards of excessive heat, dust, fumes and noxious gases in factories or foundries where aluminum, copper, lead, manganese, magnesium, paint, cement and glass are handled or produced, has been developed by Dravo Corporation, Pittsburgh. The new model is about half the size of the C-5 Dravo Crane Cab Cooler used to condition the cabs of cranes operating in extremely high temperatures such as those found near steel mill soaking pits.

Designed for operation in ambient temperatures up to 130 F, the new equipment will maintain cab tem-

This unit will maintain cab temperatures.



peratures at 80 to 85 F in the summer, and 68 to 72 F in the winter. A vertical unit, it can be mounted alongside a crane cab or placed on adjoining catwalks. Only a power supply line is needed for its installation.

Besides providing summer cooling, winter heating and continuous ventilation, the unit removes dirt and dust, gas fumes and odors from the air discharged into the cab. It is 5 ft. 5¾-in. high x 2 ft. 2-in. x 2 ft. 9-in.

Air is used for condensing purposes in the cooling coils and the refrigerant is Freon 114. To provide continuous ventilation in the crane cab, approximately 300 cfm of return air, blended with about 100 cfm is introduced into the cooler. Filters remove dirt and dust from both return and makeup air. Activated carbon cannisters in the air stream remove fumes, gases and irritants from the air supplied into the crane cab. Electric strip heaters of chrome steel sheathed with monel metal fins provide for winter heating.

All internal equipment is mounted on a structural steel frame of welded construction. The 3 hp compressor motor is supplied with positive forced ventilation by a supply of cool air from which dust, dirt and acid fumes have been removed. The ventilating air fan motor also is in the path of the cooled air.

CRUCIBLE ACQUIRES TRENT TUBE PLANT

▲ Crucible Steel Company of America announced the acquisition of Trent Tube Manufacturing Company at East Troy, Wisconsin, as a wholly-owned subsidiary.

According to W. P. Snyder, Jr., chairman of the board of Crucible Steel, the Trent Company will retain its corporate identity. It will continue under the present management, headed by Walter H. Wiewel of East Troy, president and head of operations.

Mr. Snyder stated that the stockholders of the Trent Company unanimously accepted the consideration of 45,000 shares of Crucible Steel common stock, in exchange for all of the outstanding stock of Trent.

Trent Tube Manufacturing Company was organized in 1941 to apply commercially its unique and advanced continuous-weld method for producing stainless tubing. The process was conceived by Frank E. Elge, now vice president of the Trent Company.

Trent Tube forms and welds lightweight stainless and nickel alloy steel strip into tubing by a continuous process, on special equipment designed and developed by the company. Diameters of Trent tubing range from one-eighth in. to 22 in. with walls only five-thousandths to 172-thousandths of an inch thick.

During the past decade, greatly increased industrial uses have been found for "thin wall" tubing made from stainless material.

The tubing resists corrosion and provides the finished inner and outer surfaces required for cleanness and precise chemical processes. Its lightness and the special qualities of the steel make this tubing a versatile material for tube systems and tubular construction in chemical, food, dairy, brewing, paper, fabric and other industries.

By the acquisition of these facilities, Crucible has now entered the field of tubular products for the first time in its history. For many years Crucible has been a supplier of tube billets for subsequent fabrication into seamless tubing and never sold finished tubular products in any form. It has, therefore, taken a long step forward in rounding out its special steel lines.

CARBON FIRM TO BUILD ELECTRODE PLANT

▲ Announcement is made by National Carbon Company, Inc. of its intention to build a new graphite electrode plant. Construction will be started as soon as plans are completed and technical equipment secured, so that the factory can be placed in operation at the earliest possible date.

The demand for many carbon and graphite products now exceeds even wartime peaks. Building of this plant will add materially to the carbon and graphite electrode capacity of the nation, and will keep pace with the rapidly developing use of electric furnaces for production of metals and chemicals.

High alloy steels and ferro-alloys, much rimmed and low alloy steel, and non-ferrous metals are produced in electric furnaces with the use of

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Please send me a sample copy of the G-E *Load Center Power Distribution Manual* without cost or obligation, with details on how I can arrange a FREE SHOWING of the film. (Extra copies at regular manual price—$1.00.)

Name_____ Title_____
Company_____
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GENERAL ELECTRIC

Look to Medart for...

COLD FINISHING MACHINES

Look to Medart . . . because Medart makes every type: Straightening and Turning Machines . . . billet peelers . . . bar centerers . . . bar pointers, etc. Installations throughout the entire metal industry attest their excellence and many long years of service. Medart cold finishing machines are used for working all types of metals.

NO. 4 SIZE MEDART TYPE HF BILLET PEELER

NO. 3 SIZE TYPE LS HEXAGON, FLAT AND SQUARE STRAIGHTENING MACHINE

NO. 4 SIZE MEDART CENTERLESS AUTOMATIC BAR POINTER

No. 0A SIZE MEDART TWO ROLL SINGLE MOTOR ROTARY STRAIGHTENING, SIZING AND POLISHING MACHINE

MANUFACTURING ENGINEERS OF COMPLETE TRANSMISSION EQUIPMENT AND SPECIALIZED MACHINERY

MEDART

THE MEDART COMPANY 3530 DEKALB ST. ST. LOUIS, MO.

graphite or carbon electrodes. Phosphorus, calcium carbide, carbon bisulfide and other basic chemicals are also made in electric furnaces; and chlorine, caustic soda, fluorine, sodium hypochlorite, potassium hydroxide, chlorates and other chemicals are made in electrolytic cells which employ graphite or carbon anodes. National Carbon Company, Inc., now operates electrode plants in Clarksburg, West Virginia, Columbia, Tennessee, and Niagara Falls, New York.

INHIBITOR WETS SCALE DURING PICKLING

▲ Manufacturers of iron and steel products are recognizing more than ever the importance of wetting action in modern pickling inhibitors where their processes require the use of such inhibitors.

Removal of scale, which is actually an oxide of iron, hard and abrasive enough to damage any tool with which it comes in contact, is accomplished in the pickling operation. In order to remove scale quickly in the pickling bath the solution must wet out speedily so that the time cycle can be shortened and more work put through in a given period.

This application of wetting agents to pickling compounds has been developed by E. F. Houghton and Company in its product known as Acitrol No. 100. This product contains an ingredient possessing surface active properties.

Acitrol-100 also possesses other advantages in the pickling process. It saves steel and stops pitting; it stops the evolution of hydrogen gas; it stops acid fumes; it stops the formation of smut on the steel. It also reduces hydrogen brittleness and blisters.

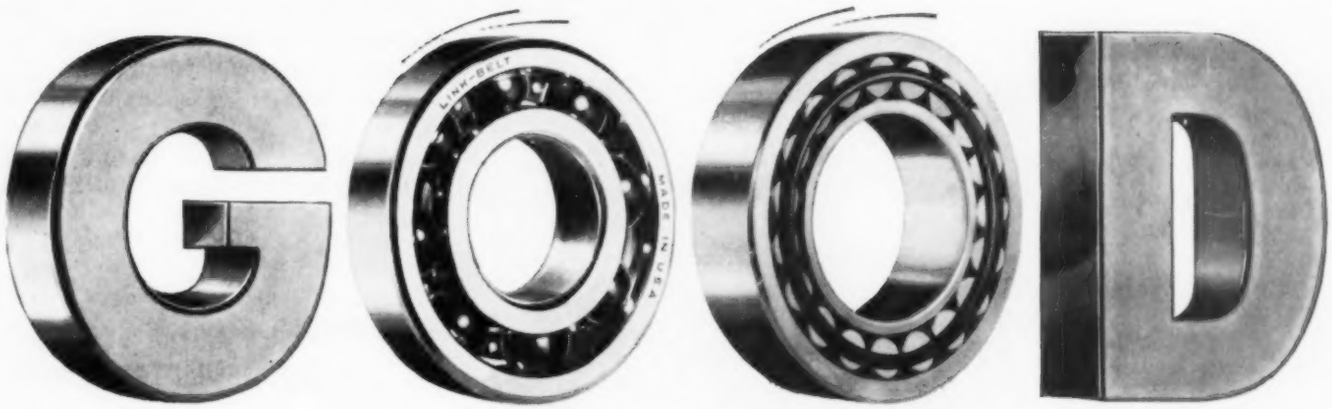
Acitrol-100 is synthetically manufactured, and is a pure chemical powder inhibitor which dissolves readily in strong or weak acid solutions.

ANNOUNCE PRICE CUT ON HYDRAULIC CONTROLS

Sperry Products, Inc., manufacturers of hydraulic controls, have announced a price reduction on their standard controls, used widely in marine and industrial fields for re-

A STATEMENT OF FACT

LINK-BELT
BALL and ROLLER BEARINGS are



BEARINGS

Yes, they've got to be good! They've got to have what it takes to carry the load . . . to handle the tough jobs as well as the easy ones . . . to roll smoothly and dependably under widely-varying operating conditions . . . to perform with complete "service-satisfaction" over a long period of time.

Once these dependable, precision-built bearing units are installed on your equipment, you'll join thousands of other satisfied users in this simple statement of fact — LINK-BELT BALL and ROLLER BEARINGS are GOOD BEARINGS.

LINK-BELT
BALL AND ROLLER
BEARINGS

Send for Catalogs!

LINK-BELT COMPANY
519 N. Holmes Ave. • Indianapolis 6, Indiana
STOCKS IN PRINCIPAL TRADING AREAS

11,150

mote control of throttles, clutches, valves, machine tools, etc. The larger "Type F" control has been reduced approximately 10 per cent in price and the smaller "Type H" control approximately 30 per cent.

The price reduction is made possible through improved production methods already in effect, and others anticipated with greater production and efficiency in a new manufacturing plant, now under construction in Danbury, Connecticut.

HARVESTER FIRM BUILDS UNIT FOR DIE STORAGE

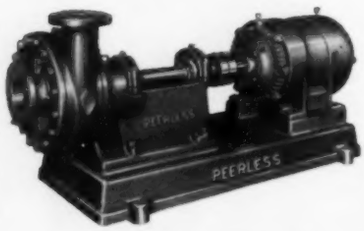
▲ A new building equipped with sturdy steel racks designed especially to store dies used for forging and to trim forgings has recently been completed adjacent to the forge shop at the Fort Wayne works of International Harvester Company. Racks are arranged along both sides of an aisle down the center of the building which is of all-steel construction and is adjacent to but not connected with the die shop that occupies one end of the forge shop.

Although most dies weigh several hundred pounds, the racks store them, each on its own skid, five high. Each skid has steel feet that rest on heavy angles riveted to uprights. Space is usable almost up to the roof truss beams which are welded to the top of the channel-section uprights that thus support the roof as well as the dies. In all, space for 465 dies is provided.

Five-high stacks are made possible by the use of fork trucks. Forks, of course, can be elevated to remove any die on its skid and the truck can then deliver the die to the die shop, if repairs are required, or directly to the forging hammers, upsetters or trim presses in the forge shop. When not in use, dies are protected from the weather and do not occupy space either in the forge shop or in the adjacent yard.

TYPE C PEERLESS *Centrifugal* PUMPS

FOR PROCESS SERVICES



Type C

TYPE C ENCLOSED IMPELLER

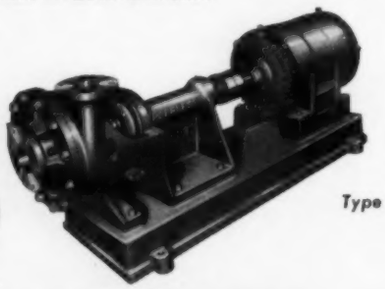
The Type C Peerless pump is a general purpose pump with an enclosed impeller designed to handle clear liquids in process services which can be of corrosive nature. It employs a single-stage, single-end suction design, with a horizontal shaft and vertically split case. Type C provides a range of capacities from 10 to 1200 g.p.m., against heads up to 231 feet and a maximum working pressure of 150 lbs Bearings are adaptable to all types of drive.

TYPE CO OPEN IMPELLER

The Type CO Peerless pump is similar in design and construction to the Type C above and has the same application However, it utilizes an open impeller to permit pumping of fluids up to 750° F with solids in suspension, brines, sludges and the like Type CO handles capacities from 10 to 1200 g.p.m. against heads to 231 feet and a maximum working capacity of 150 lbs. Adaptable to all forms of drive. Both of the above pumps are described in Bulletin 810.

TYPE ACO FOR ACIDS AND CAUSTICS

The Type ACO Peerless pump is a modification of the Type CO above, especially designed to handle caustics and acids. Both "wetted" end and drip box are built of corrosion-resistant material. Handles fluids up to 800 g.p.m. against heads to 231 feet and has a maximum working pressure of 150 lbs Fluid temperatures should not exceed 300° F. Described in Bulletin D-2400.


Type ACO

PEERLESS PUMP

PEERLESS PUMP DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

FACTORIES: INDIANAPOLIS, INDIANA: LOS ANGELES 31, CALIF.

District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 North Broadway; Atlanta Office: Rutland Building, Decatur, Georgia; Dallas 1, Texas; Fresno, California; Los Angeles 31, California.

COLUMBIA STEEL OPENS COLD REDUCTION MILL

▲ The official opening recently of the new cold reduction sheet and tin plate mill at the Pittsburg, California, plant of Columbia Steel Company, western subsidiary of United States Steel, marks the addition of approximately 400,000 net tons annually to the supply of quality steel products made by west coast steel plants for western industry.

Inauguration of this mill, the newest and most up-to-date of its kind in the country, is an important milestone in the program of additions and improvements launched by United States Steel after V-J Day, which involves an expenditure program of more than $130,000,000 in the west and in excess of $850,000,000 by United States Steel throughout the whole country.

The Geneva, Utah, plant purchased by United States Steel from the government on June 19, 1946, will play an important part in the present and future growth of Columbia Steel Company's facilities on the west coast. Upon completion of the current conversion of the Geneva plant to peacetime output, the Pittsburg, California, plant will receive hot rolled coils of semi-finished steel from Utah for processing into cold rolled sheets and tin plate. The Geneva

plant was built by United States Steel for the government, without fee or charge, to produce ship plates and structural shapes during the war. It makes steel from Utah ores, coal and limestone.

ALL-PURPOSE TURBINE FOR INDUSTRIAL USE

▲ A new all-weather general purpose turbine for driving industrial pumps, fans, blowers, compressors, paper machinery, and small generators, the Typee, has been announced by the Westinghouse Electric Corporation. A choice of three wheel sizes, 16-, 20-, and 25-in. permits these turbines to be applied over a range of 5- to 1500-horsepower with steam conditions up to 600 psi gage at 750 F, and speeds of 1000 to 7000 rpm. Equipped with heavy duty parts the turbine will operate at 1500 psig at 950 F. Many parts are interchangeable between wheel sizes.

Efficient combination felt and labyrinth bearing seals protect the turbine's lubricating system from contamination so that neither torrential rain nor the presence of abrasive dust will affect its operation. Corrosion resistant materials are used liberally throughout.

An overspeed trip simultaneously closes the governor valve and a heavy butterfly valve at a predetermined speed. Improved free-expansion center line support is arranged so that pipeline reaction is transmitted to the foundation.

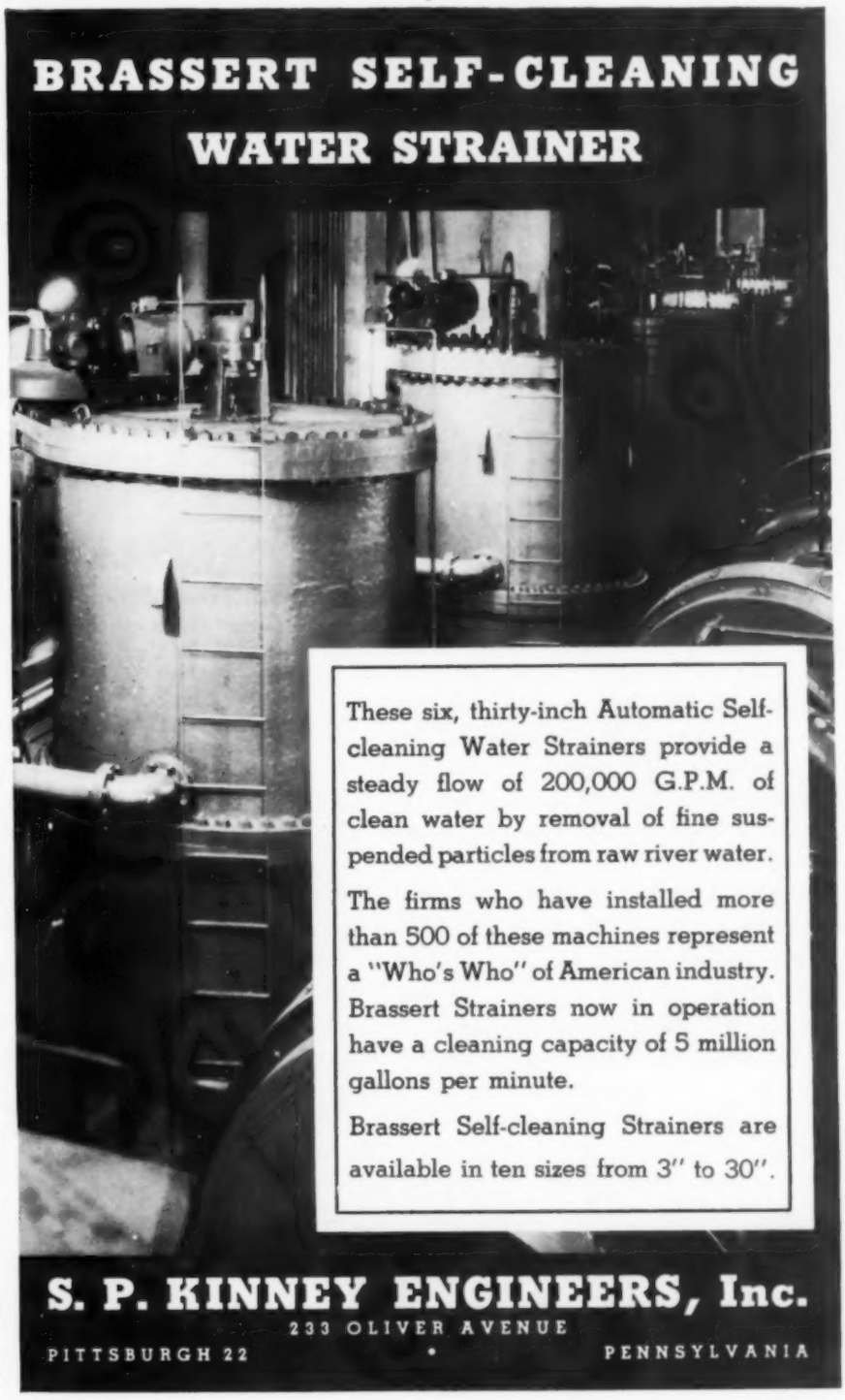
The basic turbine is equipped with a shaft type governor, mounted in a rugged casing that completely protects the governor assembly and shaft end. The entire governor assembly can be replaced without disturbing the shaft. It is interchangeable between wheel sizes. Typee turbines may be equipped with special wide speed range governors where required.

FERRO-ALLOY PLANT TO BE BUILT IN OHIO

▲ Plans for the erection of a new ferro-alloy plant near Marietta, Ohio, have been announced by Electro Metallurgical Company, unit of Union Carbide and Carbon Corporation. Construction will start in the near future, and the plant will be placed in operation at the earliest possible date.

The plant site is located on the Ohio River about six miles south of Marietta. In addition to river transportation facilities, the new plant will be served by a spur track of the Baltimore and Ohio Railroad.

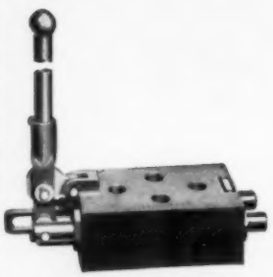
This plant will provide facilities for producing ferro-alloys of various types, which are used in the manufacture of steel and iron. These products include silicon alloys, manganese alloys, and chromium alloys. Silicon is widely used as a deoxidizer and degasifier in many grades of steel and iron and as an additive agent for high-silicon steels, which are used importantly in the electrical industry. Manganese is an essential ingredient in the manufacture of nearly all grades of steel. It improves hot-rolling properties, adds strength and toughness, and is generally used as a deoxidizer. Chromium is the principal alloying element in stainless steels and irons. Ferrochrome imparts strength, hardness, and resistance to corrosion and oxidation in other steels and irons.


BRASSERT SELF-CLEANING
WATER STRAINER
These six, thirty-inch Automatic Self-cleaning Water Strainers provide a steady flow of 200,000 G.P.M. of clean water by removal of fine suspended particles from raw river water.
The firms who have installed more than 500 of these machines represent a "Who's Who" of American industry. Brassert Strainers now in operation have a cleaning capacity of 5 million gallons per minute.
Brassert Self-cleaning Strainers are available in ten sizes from 3" to 30".
S. P. KINNEY ENGINEERS, Inc.
233 OLIVER AVENUE
PITTSBURGH 22 • PENNSYLVANIA

For a maximum of long, efficient, trouble-free service

● Quick-As-Wink Valves are high quality controls designed and built to meet the most exacting requirements. All operating parts are in pressure balance eliminating any tendency to creep or crawl. The U-shaped packers are expanded by pressure and seal tightly preventing leakage. There is no lapping—no grinding—no metal-to-metal seating. Every valve is precision made and individually tested to its full pressure rating before being shipped.

Furnished in hand, foot, pilot, solenoid and diaphragm operated designs for controlling all types of air and hydraulic equipment. Let us work with you on your requirements!



Quick-As-Wink Lever Operated Hydraulic Valves

The HS-551-N4 pictured above is a neutral position 4-way valve for controlling double acting cylinders. It has a machined steel housing, chrome plated and polished stainless steel plungers, and renewable metal rings to take the impingement of the liquid flow preventing wear on the U-packers. Used for oil or water up to 3500 P.S.I. and 150° F. Other valves available for pressures up to 5000 P.S.I.;—but send for a catalog today and get *full* details about the *complete* line.

Quick-As-Wink Control Valves

THE HIGHER THE PRESSURE THE TIGHTER THE SEAL

Manufactured by **C. B. HUNT & SON, Inc.,** *Salem, Ohio.*

Engineering and Sales Representatives in the Principal Cities

The electric power required for smelting these products in electric furnaces will be supplied by a steam-power generating station to be erected in conjunction with the ferro-alloy plant. Of the raw materials required for initial operations, silica rock and coke will be obtained from local sources.

Because of the high technical nature of the processes used at this plant and the specialized training required for its operation, a number of engineers and technical men will be moved from other plants of Electro Metallurgical Company where similar work is being done. This technical staff will form the nucleus of the operating personnel. The balance of the employees, expected to number several hundred, will be employed locally.

INDUSTRIAL STOKER HAS ECONOMICAL COMBUSTION

▲ Complete, economical combustion of any grade of coal, even lignite, is possible with the recently announced Westinghouse "Centrafire" spreader-type industrial stoker.

In the new stoker, coal is trajected by an air cooled, hydraulic motor-driven rotor so that it falls evenly over the entire length of a Westinghouse Link-Grate. Undulation of the central grate keeps the fuel bed active and moving toward the ash discharge grates at the sides. Ashes are discharged from the furnace without interrupting the coal feed, reducing load or loss of steam pressure.

A deficiency of primary air rising through the central Link-Grate is deliberately maintained. Resulting monoxides are burned in a turbulent secondary air supply above the trajectory of incoming fuels. An increased supply of the metered primary air is admitted through the side areas of the grate and ash-discharge grates to provide complete combustion.

Coal is fed to the rotor by two long-stroke, slow-speed rams. A coal-feed equalizer plate driven from the rotor oscillates across the incoming fuel to assure a continuous feed whether the coal is wet or dry.

One constant speed motor or turbine supplies oil pressure for all controls and drives. Eliminating all chain drives, this hydraulic drive permits maintaining accurately any preset fuel-air ratio.

DE LAVAL STEAM TURBINE HOST TO ENGINEERS

On September 10, De Laval Steam Turbine Company played host to a group of steel mill engineers at an open house at its Trenton, New Jersey works. The group, shown here grouped before a large turbo-blower on test, toured the entire plant which specializes in the manufacture of pumps, turbines and blowers.

LIGHT BEARINGS SAVE SPACE AND WEIGHT

▲ Savings in space and weight without sacrifice of load bearing strength are design features of the XLS bearing series now being manufactured by Federal Bearings Company, Inc. Light and compact with uninterrupted deep groove races, they are capable of taking substantial thrust loads in either direction, as well as heavy radial loads.

The XLS series is produced in sizes from 1⅜ to 10 in. bores with outside diameters from 2⅝ to 13¼ in. In the small XLS bearings, the cross section area through any pair of races may be only 68 per cent of the area of a corresponding light series metric size bearing. In the larger sizes, this area may be as small as 33⅓ per cent of the area of a corresponding size metric bearing. Such design provides a bearing that effects a saving in weight and in space without sacrificing too great a proportion of the load carrying capacity.

As a result, according to the company, these bearings may find application in compact clutches; in thin-walled housings; for large diameter shafts where the load is such that extremely high carrying capacity is not required of the bearing; in instrument or actuator design and in fact, wherever the space available for bearing installation is at a premium and weight saving of prime importance.

CROCKER-WHEELER TO BUILD AISE MILL MOTOR

▲ The Crocker-Wheeler Electric Manufacturing Company, Ampere, New Jersey, announces the addition of the AISE Standard 600 Series mill motor to its line of d-c steel mill motors.

The new Crocker-Wheeler mill motor is adaptable for use totally-enclosed, non-ventilated, or separately ventilated. It can also be furnished suitable for self ventilation. The self ventilated machines are cooled by a fan mounted at the rear of the armature; in the totally-enclosed non-ventilated motors, the fan action is provided by the back ends of the coil supports. Effective internal circulation of air lowers hot spot temperatures.

Shortened bearing housings, careful proportioning of field pole design, and the use of other modern developments in design and materials convert inactive space and weight into greater driving power.

(*Please turn to page 138*)

ANOTHER Pannier FIRST

You get fast, efficient printing of ⅛" to 2" diameter, ferrous and non-ferrous products with the Pannier Universal Marking Machine, No. C-1055-A. This "Master Marker" handles uniform and irregular lengths up to 24". It prints continuously or intermittently at 72 feet per minute. It prints in perfect register, thus correctly marks bar recesses.

Powered by a ¼ H.P. motor, the machine is equipped with a quick-change printing wheel; belt conveyor; and automatic, interior-feed ink fountain for maximum service at minimum cost.

Pannier is a specialist in design, engineering and manufacture of all types of marking equipment. Write for recommendations.

SEND FOR FULL DATA
Bulletin C-1055-A, giving detailed specifications, is yours on request.

OFFICES: Chicago, Ill. Los Angeles, Calif. Youngstown, Ohio Philadelphia, Pa.

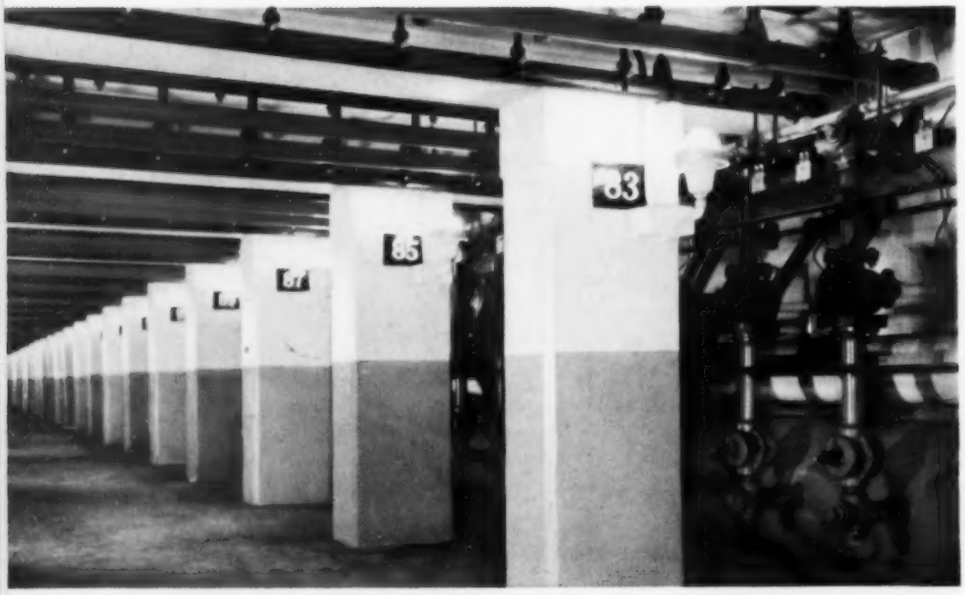
THE PANNIER CORPORATION
302 Pannier Building
Pittsburgh 12, Pa.

A BATTERY OF —

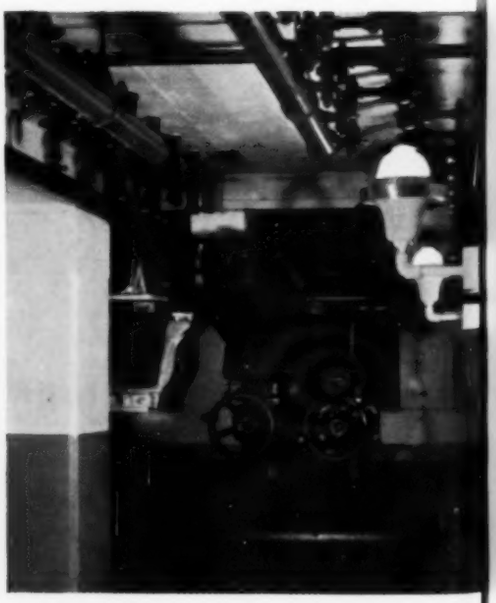
Wilputte Underjet

coke ovens is a well coordinated implement for the production of better coke at lower costs of fuel, labor and maintenance.

Careful study and development of each and every detail have achieved this result.



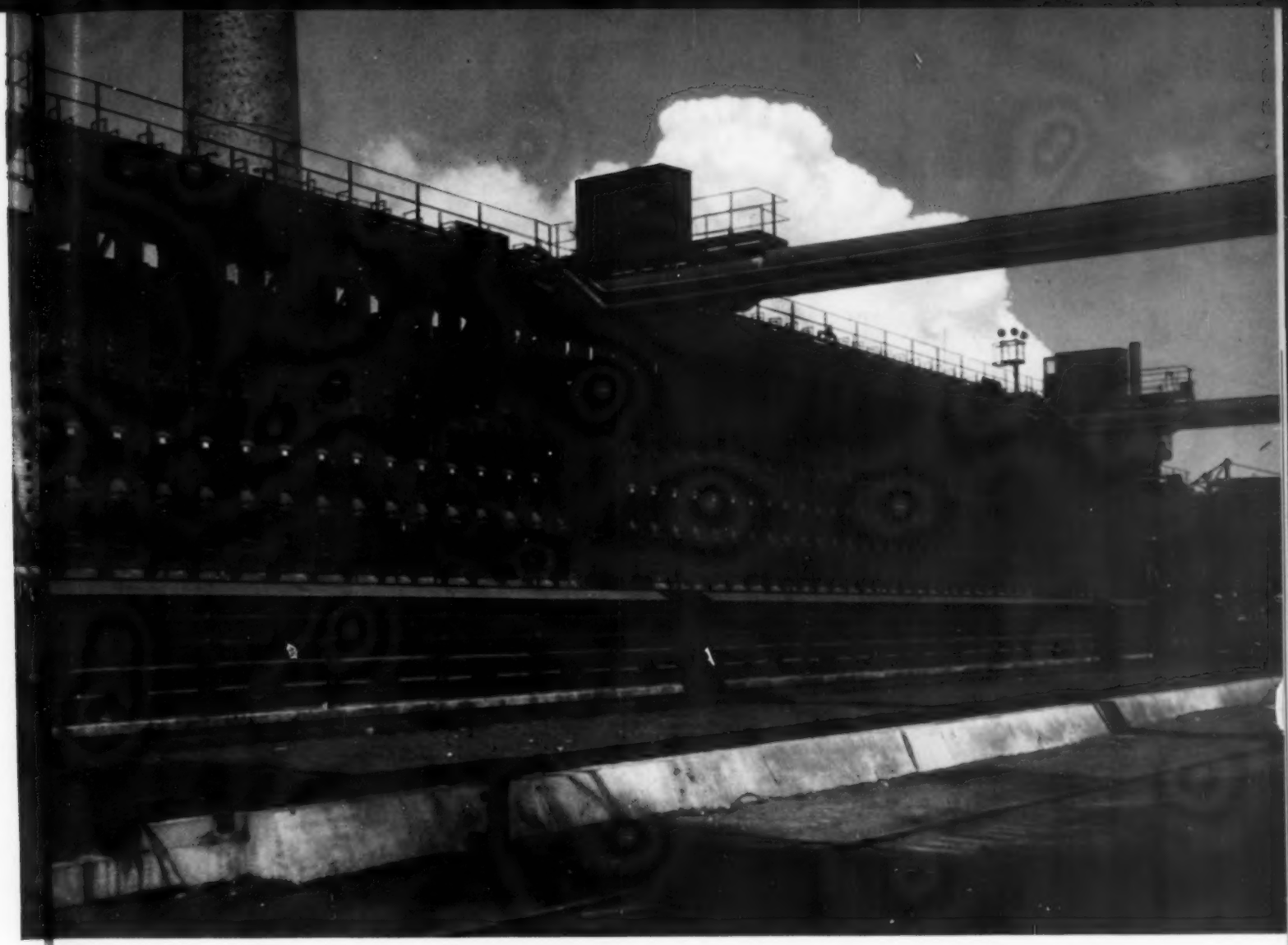
Arrangement of the rich fuel gas system in the battery basement



Details of the lean gas and air reversing

Photos by Clare

WILPUTTE



Pusher side of battery of 61 ovens recently completed for the Steel Company of Canada, Ltd., Hamilton, Ontario

Top of battery

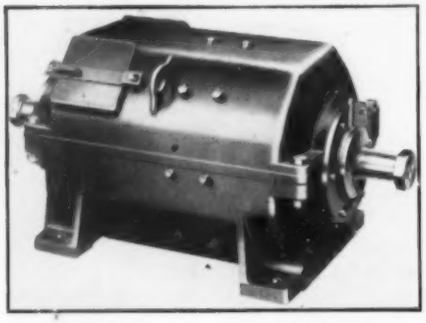
Coke side of battery

COKE OVEN DIVISION

ALLIED CHEMICAL & DYE CORPORATION

0 RECTOR STREET • NEW YORK 6, NEW YORK

(*Continued from page 135*)



The addition of the new AISE 600 series mill motor has been announced by Crocker-Wheeler.

Special grease slingers and grooves keep grease and dust away from commutator and windings. The bearing caps are readily removable to facilitate bearing inspections. The improved solid cylindrical roller bearings are completely supported against thrust and radial loads. Shaft stress is low because the bearings are close to the load.

Improved commutation is provided by split brushes and four interpoles. Ready access to the commutator bolts is provided in all motors. The coils have extra support against vibration.

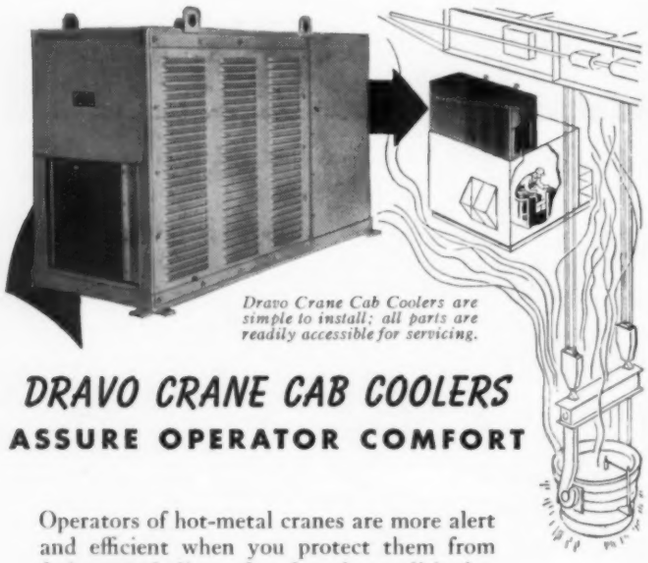
WROUGHT IRON PROVES SERVICE LOSS

▲ Metallurgical tests on specimens of old hand-forged wrought iron spikes that had been alternately exposed and submerged in the waters of Lake Michigan since 1893 revealed that, from the standpoints of tensile strength and microstructure, they compare favorably with present day wrought iron manufactured on a mass production basis.

The spikes had been used in a four-masted schooner, the Minnehaha, that was wrecked in a storm off Arcadia, Michigan, 55 years ago. The vessel was built in Gibralter, Michigan, in 1880. The damaged hull had been half submerged in sand and water ever since the wreck. About a year ago, part of the wreckage broke loose and washed ashore. The wrought iron deck spikes and pins that had held the heavier floor members together were found to be in excellent state of preservation, both inside and outside of the wood.

Carl W. Muhlenbruch, formerly associate professor of Civil Engineering, Carnegie Institute of Technology, and now associate professor of Civil Engineering at Northwestern Technological Institute, subjected samples to tensile strength tests. No well-defined yield point was observed for any of the specimens and all but one conformed to current A.S.T.M. Standard Specifications for Refined Iron Bars with respect to tensile strength.

Shape	Dimensions, in.	Tensile strength, psi	Elongation in 2 in., per cent
Spike	0.420 x 0.422	50,600	25.0
Spike	0.525 x 0.518	40,500	17.0
Spike	0.390 x 0.395	53,000	18.5
Pin	0.811 diameter	64,900	18.5



Dravo Crane Cab Coolers are simple to install; all parts are readily accessible for servicing.

DRAVO CRANE CAB COOLERS
ASSURE OPERATOR COMFORT

Operators of hot-metal cranes are more alert and efficient when you protect them from fatigue and discomfort by air conditioning the cabs with Dravo Crane Cab Coolers.

Completely self-contained, and requiring only an electrical connection, the Dravo Crane Cab Cooler provides complete air conditioning:

Cooling
Fume and Odor Removal
Dust Filtering
Continuous Ventilation
Dehumidifying
Winter Heating

DRAVO CORPORATION
PITTSBURGH • PHILADELPHIA • CLEVELAND • NEW YORK
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Sales Representatives in Principal Cities

DRAVO

For Higher Wind Volumes

AMERICAN LARSON INTAKE HOODS

Are now available for cold blast air inlet lines up to 66 in. diameter, properly contoured to give maximum intake efficiency. These 66 in. hoods are being used on the new 125,000 cfm turbo blowers being installed at modern blast furnace plants.

AMERICAN LARSON VENTILATING COMPANY
Contractors and Engineers to Industry

AMERICAN LARSON
COLD BLAST INLET HEADS FOR TURBO BLOWERS • CENTRIFUGALS
KEYSTONE BUILDING

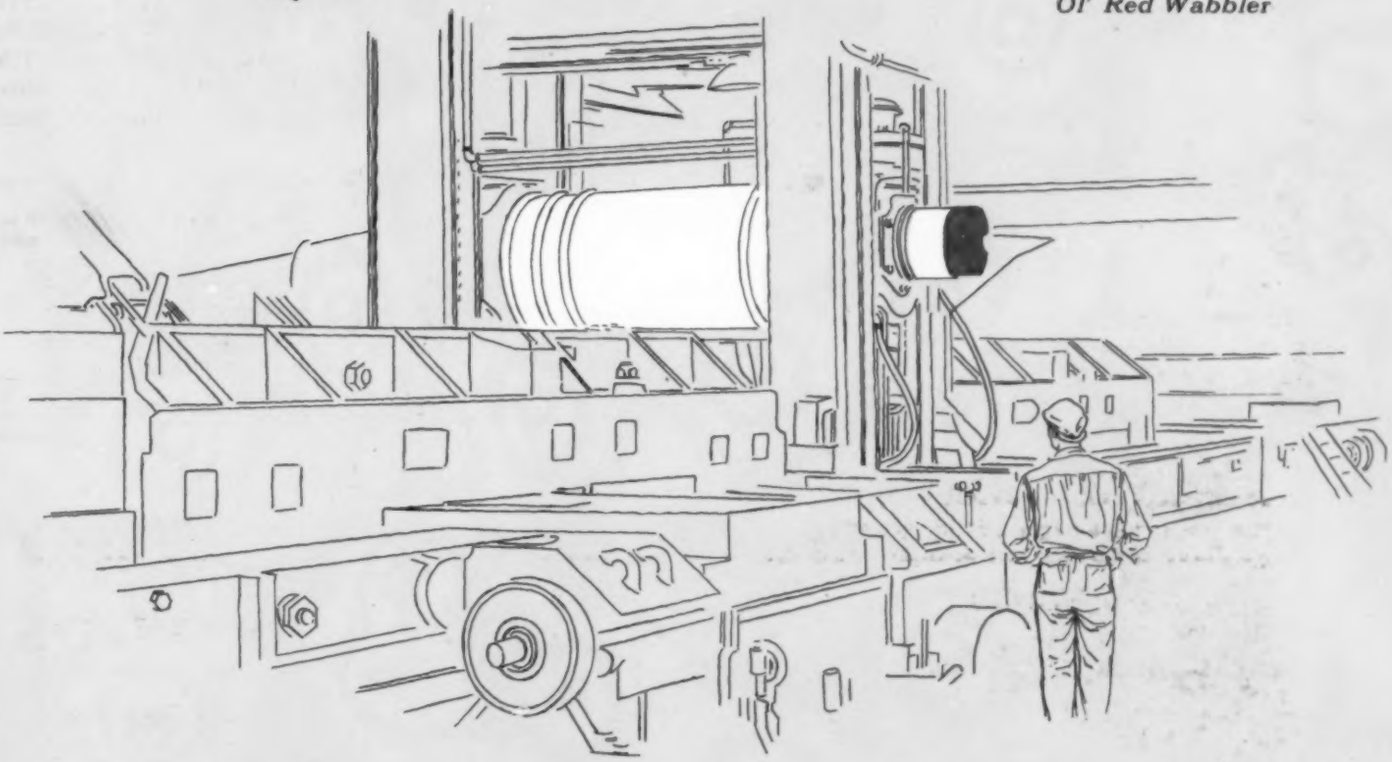
AMERICAN ROTARY LARSON VENTILATORS

NATURAL AND POWER ROOF VENTILATORS
PITTSBURGH 22, PA.

You can have my shirt

if you can tell me *what causes fire-cracking in blooming mill rolls.* Fact is, I'll send two of the finest Arrow shirts to the guy who writes me the best answer. I ain't foolin'!"*

Ol' Red Wabbler



Mackintosh-Hemphill Blooming Mill Rolls are manufactured under metallurgical and foundry practices designed to prevent fire-cracking. To accomplish this, Mill-wise Mack-Hemp engineers are constantly working with rolling-mill operators, studying the conditions and requirements of every rolling operation.

When you buy M-H Rolls—the rolls with the *red wabblers*—you can be sure that your own mill practice is the first factor considered by Mackintosh-Hemphill metallurgists and engineers in determining the most efficient rolls for your production needs.

MACKINTOSH-HEMPHILL COMPANY

PITTSBURGH AND MIDLAND, PA.

Makers of the Rolls with the Red Wabblers

OTHER MACKINTOSH-HEMPHILL PRODUCTS INCLUDE: ROLLS . . . STEEL AND SPECIAL ALLOY CASTINGS . . . COMPLETELY INTEGRATED STRIP MILLS . . . HEAVY DUTY ENGINE LATHES . . . THE NEW MACKINTOSH-ABRAMSEN STRAIGHTENERS . . . IMPROVED JOHNSTON PATENTED CORRUGATED CINDER POTS AND SLAG HANDLING EQUIPMENT . . . SHAPE STRAIGHTENERS . . SHEARS . . . LEVELLERS

*
Yes, sirree–
Just write me giving your opinion on fire-cracking, before December 1, 1948, and I'll send that pair of Arrow Shirts for the best answer.
Ol' Red Wabbler
Mackintosh-Hemphill Co.
Pittsburgh 3, Pa.

One of the spikes, approximately ½-in. square and 6 in. long was examined in the metallurgical laboratory of A. M. Byers Company, Pittsburgh, wrought iron manufacturers.

The analysis showed that the material in the spike has the same distinguishing characteristics as present day wrought iron—iron-silicate slag uniformly distributed throughout the metallic matrix. It is the presence of this slag that is principally responsible for wrought iron's resistance to corrosion.

There was some variation in chemical composition of the older wrought iron but Byers metallurgists explained this is not uncommon because, in previous years, knowledge of fuel was limited and necessary heat for the hand forging undoubtedly was supplied by a blacksmith's fire.

Analysis of drillings taken from the wedge-shaped, pointed out end of the spike showed the chemical composition to be:

Carbon	0.012 per cent
Manganese	0.020
Phosphorus	0.274
Sulphur	0.040
Silicon	0.190
Slag	3.04

U. S. STEEL BUILDS DORMITORY UNITS

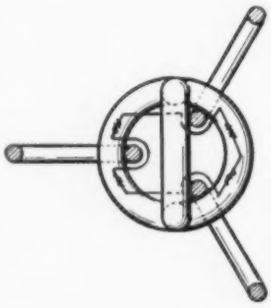
Next door to the largest steel plant in the world, these 38 housing units will soon be ready for occupancy by newly-recruited, unmarried male employees of the Gary, Indiana, Works of Carnegie-Illinois Steel Corporation. Unable to obtain adequate housing for new employees, this U. S. Steel subsidiary plant decided to do something about it. Last March it let a contract for $292,000 to have these dormitory units constructed just adjoining one of the mill gates. Each unit will contain six bedrooms, shower and bath facilities and lounge. The first buildings are scheduled for occupancy in mid-September.

...LONGER LASTING
MAGNET CHAINS

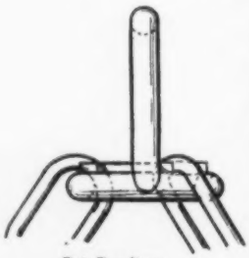
The use of heat-treated high alloy steel throughout suspension makes periodic annealing unnecessary.

Reduce Breakdown Time!

Our FRICTIONLESS chains last up to 3 times as long as old-style suspensions. Write for prices. Prompt shipment from stock.



Ring plate keeps chain separated. Eliminating twisting and rubbing, and keeps magnet level.



Pat. Pending

Suspension chain for 55" magnet tests to 89,000 pounds.

Suspension chain for 65" magnet tests to 115,000 pounds.

DOWNTOWN Company
1836 EUCLID AVE. • CLEVELAND 15, OHIO

CRANE BUILDERS Since 1903

BEDFORD CRANES

Capacities 5 to 150 Tons

Designed and Engineered to Meet Your Requirements

Any Span or Lift
Send For Your Copy Of Catalog

ELECTRIC OVERHEAD TRAVELING CRANES
GANTRY CRANES • STEEL DERRICKS
BUILT TO YOUR SPECIFICATIONS
STRUCTURAL STEEL • STEEL BUILDINGS

BEDFORD FOUNDRY & MACHINE CO.
Engineers
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BEDFORD, INDIANA
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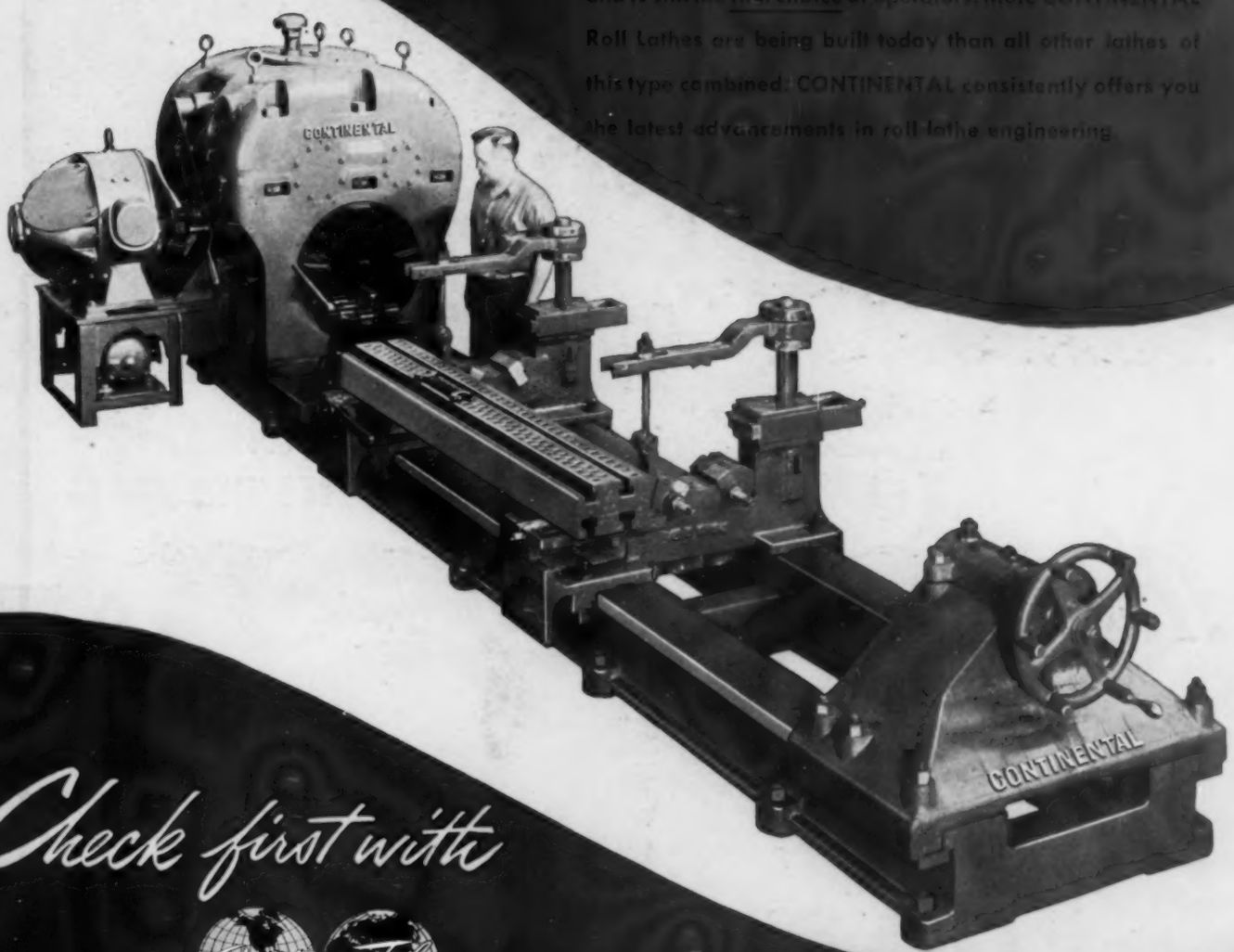
Gray Iron Castings

Continental

Industry's Major Source for ROLL LATHES

And there is a reason! The CONTINENTAL Roll Lathe is the original chatter-proof, totally enclosed headstock lathe, and is still the first choice of operators. More CONTINENTAL Roll Lathes are being built today than all other lathes of this type combined. CONTINENTAL consistently offers you the latest advancements in roll lathe engineering.



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BAR MILLS

CORRECTLY ENGINEERED
FOR TODAY'S REQUIREMENTS

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Industry's Headquarters for
Rolling Mills and Equipment
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Aetna-Standard

Newest development in continuous butt weld pipe—a 10 stand mill.

Aetna-Standard is now completing the two fastest seamless tube mills in the world.

AETNA-STANDARD leads the world in engineering, designing and building of seamless tube mills and continuous butt weld pipe mills. They build more pipe and tube mills than all other companies combined.

DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries

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ASSOCIATED COMPANIES:

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AETNA-STANDARD ENGINEERING COMPANY, LTD., TORONTO, ONTARIO, CANADA

the Crane SAFETY LIMIT STOP

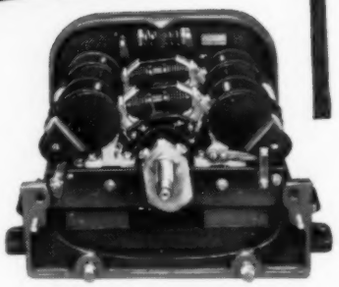
...THAT SET *New Standards of Performance*

There probably has never been a crane safety limit stop switch that so completely embodies *all* the wants of steel mill engineers as the Type P-100 Cutler-Hammer Safety Limit Stop, for 41 to 100 H.P. installations or the P-200 Safety Limit Stop for 101 to 200 H.P. installations. This is demonstrated by the fact that time after time engineers have taken one look at it and said: "That is what I want".

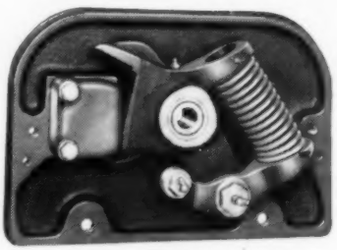
C-H Type P-100 100 H. P.

C-H Type P-200 200 H. P.

The photographs shown here tell their own story . . . a story of simple design . . . of rugged construction . . . of dependable, unfailing operation. The Cutler-Hammer Crane Safety Limit Stop has set new standards of performance every time, every way. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wis. *Associate*: Canadian Cutler-Hammer, Ltd., Toronto.



Movable contacts and arc shields in position. (Operating head removed).



Inside view of removable head, showing snap action mechanism.

Combined operating lever and tripping weight.

CHECK THESE OUTSTANDING FEATURES

Low headroom required.

Totally enclosed tripping mechanism—can't be made inoperative by rain, snow, ice, dirt or falling objects.

Slate contact supports, slotted, provide ample insulation to ground.

Snap action make and break —hammer blow of tripping is absorbed by spring bumper.

Cover strong enough to support a man's weight.

Rigid one-piece construction of operating lever and tripping weight.

Only one hanging weight, and that has double guides, adjustable to meet any practical installation condition, to prevent fouling the weight by the hoisting cables.

The snap action is obtained from a compression spring, with a very low unit stress. Even if it should break, the mechanism will operate because spring is held in place by an inside guide.

Ball bearings, with means for lubricating by standard grease fittings, used throughout.

Flexible leads brought out for ease of installation.

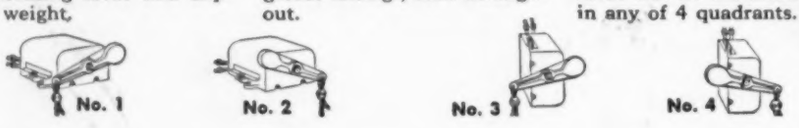
Gasketed cover to keep out dirt.

Mounting interchangeable with old style P-2.

Blowouts latched in place when mounted in position (3) or (4).

Cover chained to case to prevent dropping to ground during inspection.

(Below) Operating lever can be mounted in any of 4 quadrants.



CUTLER-HAMMER
MOTOR CONTROL
C-H

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress March 3, 1879. $7.50 per year in United States, $8.25 Canada, $10.00 foreign countries. Volume 25, No. 10.

ANNOUNCE SWITCHES FOR FRACTIONAL HP MOTORS

▲ A new line of manual starting switches for use with fractional-hp motors has been announced by General Electric's control division. The new switches are furnished in five different types: with general-purpose enclosure; without enclosure; a combination unit and selector switch; with cast iron enclosure for wet locations, and a similar type for dusty or hazardous locations. The switches are desirable for use with fractional-hp motors driving blowers, pumps, ventilating systems, small machine tools, and a wide variety of similar applications.

An important feature of all five types is a molded base of moisture-resisting insulating material which mounts and encloses the mechanism and contacts. This particular construction serves not only to protect

the operating parts from dust and physical contact, but to direct the heat concentration to the sturdy bimetallic tripping device, thus assuring that the action of the overload is quick and positive. Another feature is the action of the switch handle, which moves to the "off" position on overload, thus giving positive indication that the power is shut off. The wheel-type movable contact cleans as it rolls against the stationary contacts, and, in addition, recedes into a recess in the base, thus effectively snuffing the arc.

All parts of these switches are rust-resisting, readily accessible wiring terminals on the tops of the units facilitate easy wiring, and the screws for fastening the molded back cover are attached to the cover to prevent their being lost.

Complete

FIRE PROTECTION

HAS 3 VITAL PHASES

- ***EXTINGUISHMENT***
- ***PREVENTION***
- ***DETECTION***

Are you sure that each of these links in *your* fire protection program is as strong as it should be? A careful analysis of your fire hazards now . . . in the light of recent developments in fire protection methods and equipment . . . may save you staggering fire losses later. Let Cardox . . . a leader in all three phases of fire protection . . . help you make this property-protecting check-up! The only cost to you is a small investment in time.

CARDOX offers all THREE

EXTINGUISHMENT

Cardox engineered applications of low-pressure carbon dioxide give this fast-acting, non-damaging extinguishing medium maximum effectiveness in conquering fires, large or small, both indoors and out. Cardox Fire Extinguishing Systems offer broadscale protection with centrally located, compactly designed storage units with capacities of 500 pounds to 125 tons of Cardox CO_2, and Mobile Units with capacities of 750 pounds to 3 tons. Bulletin S-4108.

PREVENTION

Cardox Atmosphere Inerting Systems are available to provide inert gas for continuous fire and explosion prevention in the handling and storage of flammable liquids, chemicals, paints, varnishes, and solvents, or where other materials in storage present serious fire and explosion hazards. These systems also are used to provide an economical source of inert gas as part of continuous production processes. Bulletin C-4108.

DETECTION

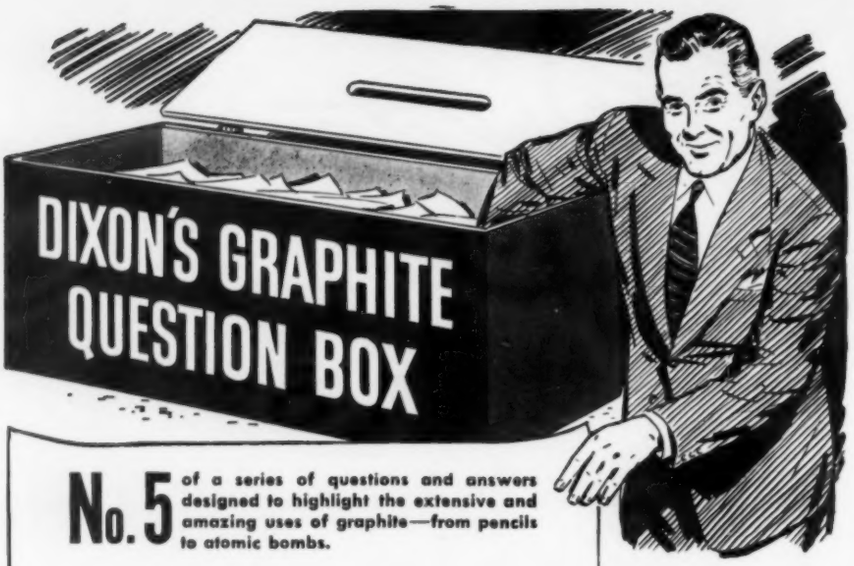
Cardox Detection Systems, give prompt warning of incipient fires. These systems . . . with detectors located throughout large establishments . . . may be used purely as a warning device, or may be engineered to actuate an extinguishing system.

CARDOX

CO_2 FIRE EXTINGUISHING SYSTEMS

CARDOX CORPORATION • 307 North Michigan Avenue, Chicago 1, Illinois

DISTRICT OFFICES: NEW YORK • PHILADELPHIA • PITTSBURGH • CLEVELAND • DETROIT ST. LOUIS • SAN FRANCISCO • SAN DIEGO



No. 5 of a series of questions and answers designed to highlight the extensive and amazing uses of graphite—from pencils to atomic bombs.

GRAPHITE IN THE ROLLING MILL

QUES. Why is graphite used in boiler water?

ANS. To prevent scale from burning fast to the shell and tubes. Boiler cleaning is made fast and easy, reducing cleaning time, labor cost and fatigue.

QUES. Is graphite effective in lubricating, retarding wear and prolonging the service life of dies and punches?

ANS. Definitely yes. Graphite, a "solid" lubricant, is not readily forced or squeezed out between surfaces under pressure as with oil, grease or fluid lubricants. It often serves best when all other lubricants completely or partially fail.

QUES. Does graphite speed up assembly of stamped, forged, machined or cast parts?

ANS. Reported savings in labor, time and operator fatigue are almost incredible. Many manufacturers barrel-tumble parts, a low-cost automatic method of coating them with graphite.

QUES. Is graphite the best lubricant for chains, bearings and other parts of industrial ovens, lehrs and kilns that operate at high temperatures?

ANS. Graphite is the only lubricant that proves wholly and lastingly adequate in such service.

QUES. How are graphite products used in welding and brazing?

ANS. As electrodes, and as "stoppers" or "fillers" to plug openings and keep work areas and work free from excess flux and spelter.

A few of thousands of widely used products containing Dixon's Graphites. Those starred are Dixon's products, many of them sold by supply houses everywhere.

★ Lathe Center Lubricant

★ Graphitoleo

★ Cup Grease No. 3

Now may we receive *your questions* on how graphite can help *you?*

DIXON'S GRAPHITES

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JOSEPH DIXON CRUCIBLE COMPANY
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LOOK FOR No. 6
in this series. We will gladly send you reprints of any you may miss

Book Review

▲ NFPA Handbook of Fire Protection (Crosby-Fiske-Forster). Tenth Edition. Edited by Robert S. Moulton. National Fire Protection Association, 60 Batterymarch Street, Boston 10, Massachusetts. 1500 pp. 5¼ x 7½ in. Price $9.50. The 10th Edition of this handbook, like its distinguished predecessors, presents in compact form, for ready reference, the essential information on fire prevention and protection that time has crystallized into good practice. It covers both life safety from fire and the protection of property. The handbook is the only reference volume of its kind available today. It represents a full two-years work on the part of the National Fire Protection Association staff with the assistance of more than 100 expert consultants.

Among the many completely new subjects treated in the 10th edition of the handbook are a new chapter on the chemistry and physics of fire, a new chapter on water spray (fog) protection, a complete new treatment of the general field of building construction, with several new chapters giving detailed information about the various building types and related matters, including interior finish and insulation, flameproofing treatments, tables of fire resistance ratings of walls, partitions, floors, columns, roofs, etc., as established by laboratory tests.

Information is given as to the properties, hazards, proper storage practices and best extinguishing methods for hundreds of different solvents and chemicals.

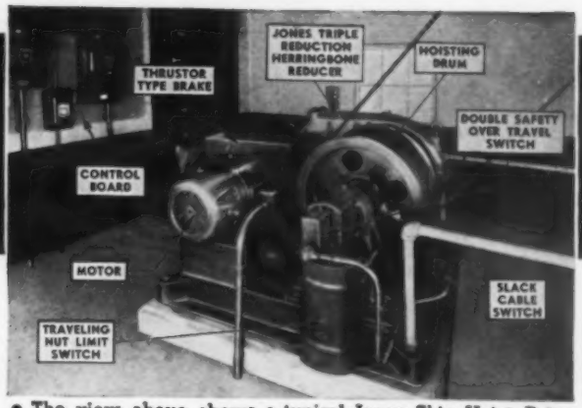
For Economical Material Handling

JONES SKIP HOIST DRIVES

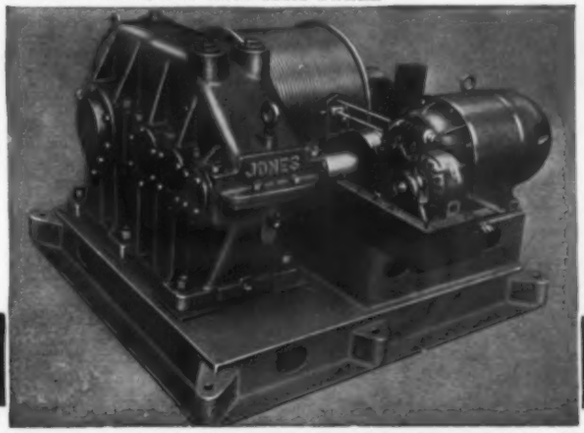
FOR speedy operation, reliable service and over-all economy the Jones Skip Hoist Drive has made a name for itself in a wide variety of material handling service. These skip hoist drives are built as complete units by the Jones organization in several types with base to take any motor specified by the purchaser. They are equipped for all the modern protective devices such as cam or nut type limit switches, solenoid or disc type brakes and slack cable switches. The drives are single, double, or triple reduction Jones Herringbone Speed Reducers, built to stand up under the many years of pounding that a skip hoist drive has to take. The shafts are supported in roller bearings, with rolling action, rack generated gear and pinion teeth to insure easiest possible starting with low starting-peak loads. All reducer bearings and gears are automatic oil-bath lubricated.

The Jones organization has an extensive file of information on skip hoist drive problems and will be pleased to work with you on any problems involving such applications.

W. A. JONES FOUNDRY & MACHINE CO.
4431 Roosevelt Road, Chicago, Illinois

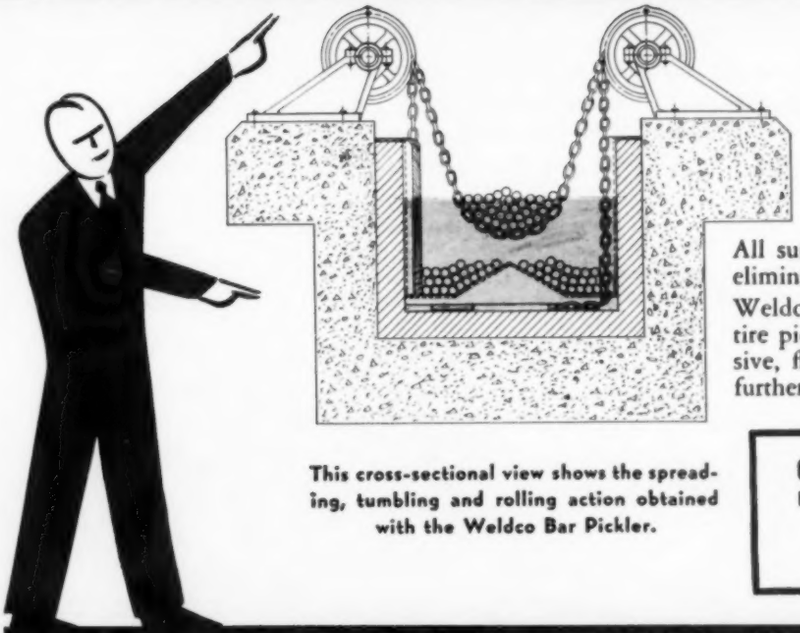


• The view above shows a typical Jones Skip Hoist Drive installation while the view below shows one of the Jones units equipped with traveling nut type limit switch, motor actuated brake, and slack cable switch.



jones HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES
ANTI—FRICTION PILLOW BLOCKS • PULLEYS
FRICTION CLUTCHES • TRANSMISSION APPLIANCES

For economical, time-saving pickling
the *New* **WELDCO** Mechanical Picklers
save Man power, Maintenance and Money



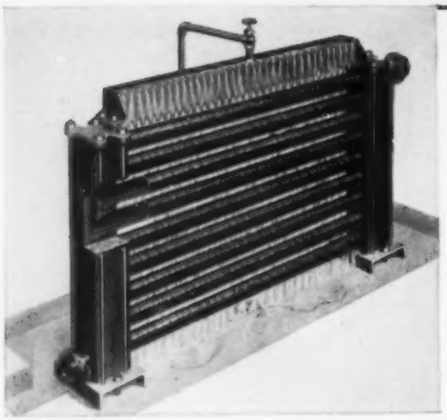
This cross-sectional view shows the spreading, tumbling and rolling action obtained with the Weldco Bar Pickler.

If you're pickling round, hexagon or square bars, coils, flats, tubing or sheets, the Weldco Mechanical Picklers are your best bet to increase tonnage at reduced cost. Easy to operate and control, the Picklers save 40 to 60 percent pickling time by combined mechanical agitation and chemical action, and eliminate the use of an overhead crane and operator. All surfaces are equally exposed and over-pickling is eliminated by a pre-determined cycle.

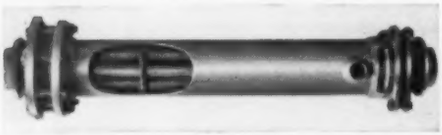
Weldco engineers can furnish all facilities for your entire pickling department, including our new, inexpensive, floor-operated crane. Write or phone today for further information.

OTHER WELDCO PICKLING PRODUCTS
Include Pickling Crates, Baskets, Chains, Hairpin Hooks, Jets, and Scrubbers.
CATALOGS AVAILABLE ON REQUEST

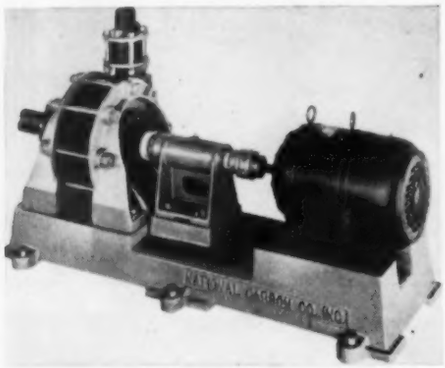
THE YOUNGSTOWN WELDING & ENGINEERING COMPANY
3700 OAKWOOD AVENUE . . . . YOUNGSTOWN 9, OHIO



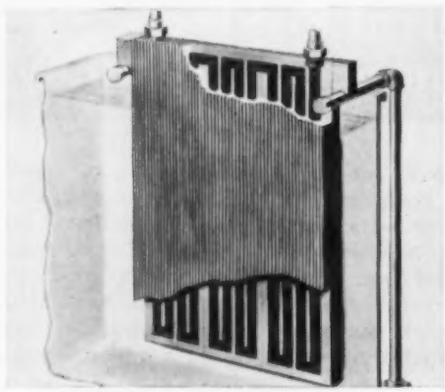
"Karbate" Sectional Cascade Cooler



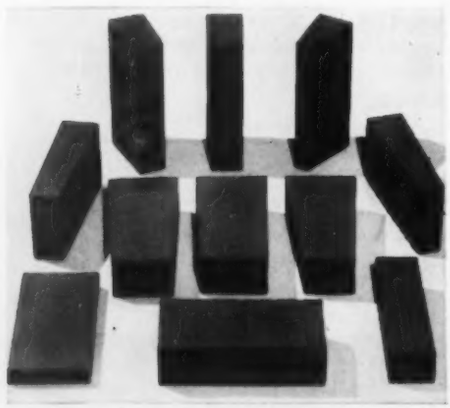
"Karbate" Series 70 Heat Exchanger



"Karbate" Pump



"Karbate" Plate Heater



Carbon Brick for Tank Lining

How to lick corrosion if you pickle or plate metal . . .

USE NATIONAL CARBON PRODUCTS

FOR HEATING, cooling, pumping, and conveying the corrosive solutions used in pickling and plating metal, there's no better equipment than that made of "Karbate" brand Impervious Graphite. This material is chemically inert, immune to thermal shock, easy to machine and install, light in weight yet strong; and has a very high heat-transfer rate.

Operating experience has proved that "Karbate" equipment stands up in sulphuric, hydrochloric, and nitric-hydrofluoric pickling solutions . . . Parkerizing and Bonderizing baths . . . nickel, copper, tin, and zinc plating solutions . . . electro-polishing and Alumilite and Alzak processes.

"National" carbon brick is now extensively used for lining tanks that handle corrosive solutions — particularly nitric-hydrofluoric.

For more details on metal-cleaning systems of standard "Karbate" brand Impervious Graphite units and "National" carbon brick, write to National Carbon Company, Inc., Dept. IS.

These products sold in Canada by Canadian National Carbon Company Limited, Toronto 4

The registered trade-marks "Karbate" and "National" distinguish products of

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

UCC

30 East 42nd St., New York 17, N. Y.

Division Sales Offices:
Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

Personnel News . . . .

P. J. Britt has been appointed superintendent of industrial relations at the Buffalo plant of the Colorado Fuel and Iron Corporation, effective September 1, 1948. Mr. Britt was chairman of the Buffalo section of the AISE during 1947-48 and will be on the AISE board of directors in 1949.

Richard E. Hoagland was appointed manager of by-products sales by Kaiser Company, Incorporated, operators of the Fontana steel plant. In this capacity Mr. Hoagland will assume direct sale of all by-products formerly sold through the W. E. Major Industries, Los Angeles.

Walton P. Lewis has been appointed district electrical sales engineer for American Steel and Wire Company at Pittsburgh, Pennsylvania, in a new and separate sales division which has been created to handle the electrical wire and cable products of American Steel and Wire Company. Establishment of the new division with four regional sales offices throughout the country will permit concentration of sales effort on such items as paper insulated cable, rubber jacketed cable, galvanized telephone wire, and amerductor, the transmission cable used for rural electrification lines.

T. F. Peterson, who has headed the section of the general sales staff of the American Steel and Wire Company devoted to electrical products, will serve as manager of sales of the new division. Four new district sales offices under the new organization will be established in Boston, Cleveland, Chicago and New York.

Walter E. Mackley has been appointed manager of the New York district office of American Steel and Wire Company, United States Steel subsidiary. **F. L. Nonnenmacher** has been named manager of manufacturers' products sales to succeed Mr. Mackley, while **Harold Christopher** has been promoted to the position of assistant manager of that department. Mr. Mackley succeeds **B. W. Bennett,** who has been named assistant to the vice president-sales of the American Steel and Wire Company In his new capacity, Mr. Bennett will continue to maintain his office in New York, and will handle special assignments. Mr. Nonnenmacher also started in the New York office as a mail boy in May, 1918. He held a variety of positions there and in Buffalo, New York, before being appointed assistant manager, manufacturers' products department in the New York sales office in January, 1944. Mr. Christopher has been with American Steel and Wire Company since July, 1923, when he started as a clerk in the New York sales office. Since January, 1945, he has been a salesman in the manufacturers' products sales department.

George M. Ullom was made district sales manager at Portsmouth, Ohio, for the Harbison-Walker Refractories Company. Mr. Ullom was formerly connected with the St. Louis sales office with headquarters in Kansas City, Missouri. Born in Washington, Pennsylvania, Mr. Ullom lived in the Pittsburgh district for many years, and attended Carnegie Institute of Technology. He began his career with Harbison-Walker in 1929 as assistant sales correspondent. He served in various other sales capacities until 1940 when he was transferred to the Portsmouth sales office. He was transferred to the St. Louis district in 1947.

William F. B. Henderson is returning to Detroit to take a position with the E. W. Bliss Company. Mr. Henderson was appointed executive vice president and was elected to the board of directors at its meeting on September 28.

Mr. Henderson was formerly general manager of Briggs Manufacturing Company's plumbing division, and, for the past four years, executive vice president and director of Clearing Machine Corporation, Chicago. After World War I, he was associated with Maxwell Motors and Budd Manufacturing Company. The E. W. Bliss Company manufactures mechanical and hydraulic presses, rolling mills, and can and container machinery.

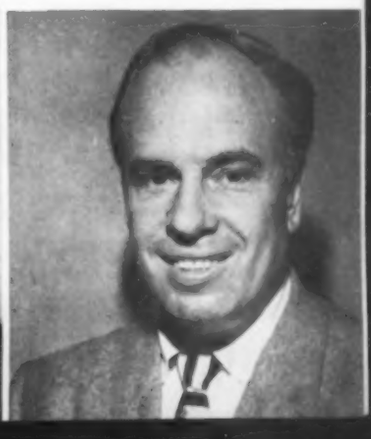
John H. Poulson was recently appointed to the board of regional sales supervisors of the Eutectic Welding Alloys Corporation. Mr. Poulson became associated with Eutectic Welding Alloys Corporation as a field engineer, was advanced to the position of assistant to

P. J. BRITT

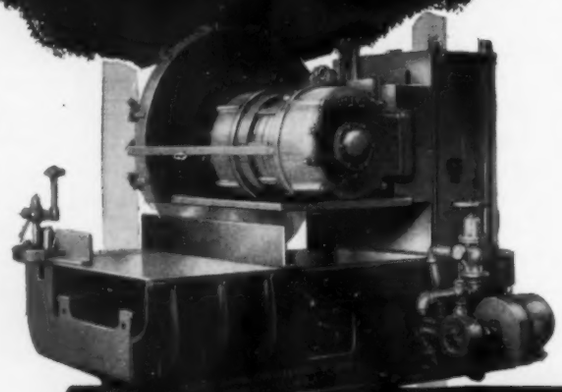
GEORGE M. ULLOM

WILLIAM F. B. HENDERSON

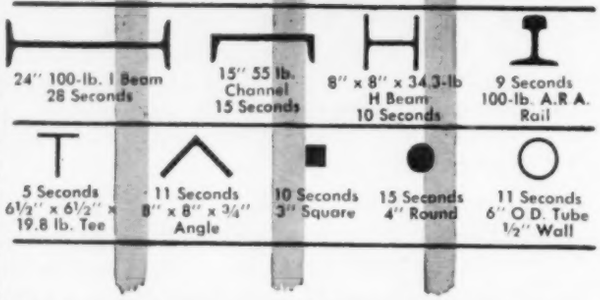
JOHN H. POULSON



Modern Sawing



with KLING HIGH SPEED FRICTION SAWS



Friction sawing is one of few mechanical processes which employ the heat of friction in a useful manner. It concentrates heat on the material to be severed at a rate which is faster than it can absorb heat. The immediate temperature rise of the contact surface is so great that its strength is reduced considerably lower than that of the colder blade rim. This heated surface is readily removed by the blade and permits complete severing of the material rapidly with no loss of metal from the blade.

Because of its versatile ability to cut many varied structural shapes, as well as solid or hollow bars in any sequence, without change of blade or set-up, one machine can handle a volume of cutting that would otherwise require several separate shears or slow speed saws.

Consult Kling engineers regarding your metal cutting problems. State size of material to be cut. Bulletin No. 9200 giving full particulars and suggestions as to the type and size of saw will be mailed promptly. No obligation.

KLING BROS. *Engineering Works*

Punches; Bar, Angle and Rotary Shears; Combination Shear, Punch and Copers; Plate and Angle Bending Rolls; Heavy Duty Grinders

1324 N. KOSTNER AVENUE, CHICAGO 51, ILLINOIS, U. S. A.

the general sales manager and has recently been appointed a Eutectic regional sales supervisor in eastern United States and Canada, responsible for that group of 160 Eutectic field engineers active in that area.

J. R. Davey, general foreman, finishing, Jones and Laughlin Steel Corporation, Aliquippa works, has been appointed to succeed Mr. Powell as assistant superintendent, tin plate department.

Cecil T. Snyder, general foreman, Jones and Laughlin Steel Corporation, Aliquippa works, cold rolled sheet, replaces Mr. Davey as general foreman, finishing.

J. Russell Powell was appointed superintendent, tin plate department, Aliquippa works, Jones and Laughlin Steel Corporation effective October 1, 1948, succeeding C. A. Kral, resigned.

J. J. Murray, who has served in various export capacities with Hewitt-Robins, Incorporated during the past 28 years, has been appointed to the newly created position of export manager for the corporation, effective immediately. The announcement was made by J. H. Hayden, Hewitt-Robins vice president.

Murray has for some years supervised export activities of the Hewitt Rubber division, but only recently assumed direction of export activities for the Robins Conveyors and Restfoam divisions.

C. G. Turner has been named director of the industrial relations department, Timken Roller Bearing Company, Canton, Ohio.

E. B. Forse, presently manager of the refractories division of the Carborundum Company at Perth Amboy, is appointed assistant vice president effective November 1, 1948. In this capacity, he will undertake special assignments relative to problems arising from the expanding markets for refractories and crude silicon carbide. For the present, his headquarters will remain at Perth Amboy.

C. E. Hawke, presently director of sales for the Carborundum Company, will become manager of the refractories division on November 1, 1948, with full responsibility for the direction of this important division's sales and manufacturing.

E. R. Baxter is appointed director of sales and sales administration for Carborundum Company to succeed C. E. Hawke on November 1. In his new capacity, Mr. Baxter will assume full responsibility for the direction of the field sales force and the co-ordination of all field sales activities with those of the various divisions of the company.

G. R. Rayner, Jr. will become assistant director of sales administration under Mr. Baxter and charged with the responsibility for the various phases of sales administration at Niagara Falls and in the district offices.

G. A. Watson was appointed manager of sales for the Chicago division of Electro Metallurgical Sales Corporation. He succeeds **J. H. Spillane,** who has been transferred to the general sales office in New York. Mr. Watson had previously served in various sales and service capacities in both the Chicago and Detroit offices of the company, which is a unit of Union Carbide and Carbon Corporation.

P. J. Jensen, formerly executive engineer in the engineering and research department at Carboloy Company, Inc., Detroit, was made manager of the Michigan district for Carboloy with headquarters in Detroit. Jensen succeeds **M. E. Knoll** who is retiring after 19

years service with Carboloy, 18 of which he spent as manager of the Michigan district. Jensen graduated from the University of Nebraska with a B.S. in mechanical engineering in 1936. He was tool engineer at Carboloy from 1937 until 1941. Between 1941 and 1946, Jensen served in the U. S. Army Ordnance Department with rank of lieutenant-colonel. Returning to Carboloy in 1946, Jensen was appointed executive engineer and served in that capacity until his present appointment.

James Boyd, formerly eastern district manager of the Westinghouse Electric Corporation, has been appointed general sales manager of the Lima-Hamilton Corporation's Hamilton division. The Hamilton division manufactures diesel and steam engines, machine tools, presses for the automotive industry, can-making and special machinery, and other industrial equipment.

Louis W. Mason has been appointed assistant to the general manager of sales of National Tube Company. Succeeding Mr. Mason as manager of National Tube's Pittsburgh sales office is **Henry C. Hoar,** formerly manager of sales at St. Louis. Mr. Mason was first employed by National Tube in 1923 in the purchasing department, eventually becoming assistant purchasing agent. He became manager of purchases for the Tubular Alloy Steel Corporation in Gary, Indiana during the wartime period. He later joined the sales department of National Tube in Washington, D. C., and came to Pittsburgh in 1946 as district manager of sales.

Mr. Hoar, a graduate of Massachusetts Institute of Technology, joined National Tube in 1927. He served in various capacities in the sales department and became manager of sales at St. Louis in 1946.

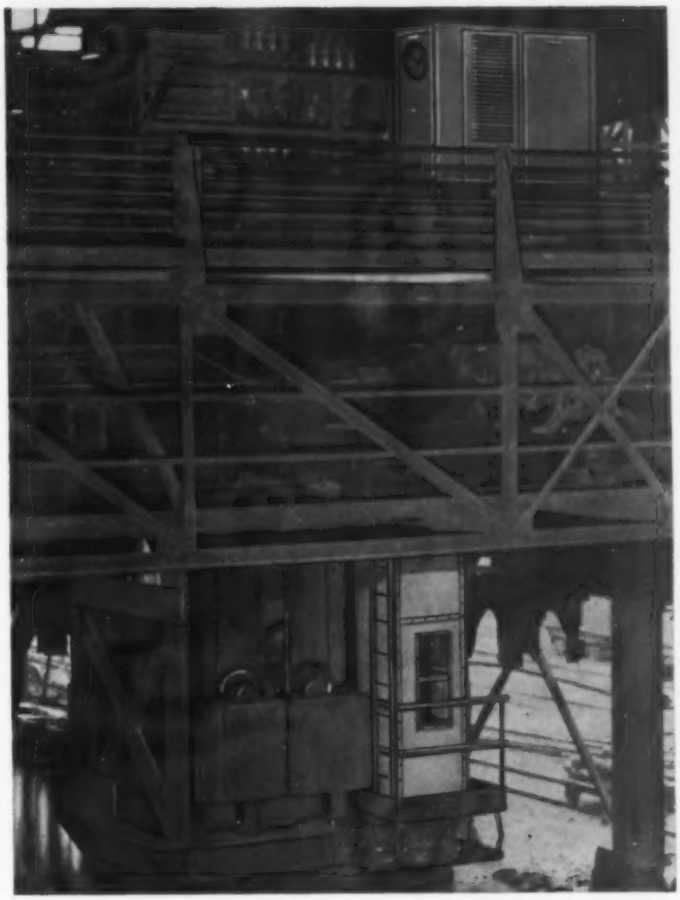
Glendon P. Robb will succeed Mr. Hoar as manager of sales, National Tube Company, in St. Louis.

Ira S. Latimer has been made the eastern Michigan sales agent of The Heil Process Equipment Corporation, Cleveland, Ohio. He is an experienced steel mill metallurgist. For twelve years, he was associated with the Rotary Electric Steel Company of Detroit, as metallurgical engineer, sales metallurgist, and Chicago district manager. Mr. Latimer brings to his new enterprise a thorough technical and business background that will be helpful to those interested in chemical-proof equipment (tanks, linings, heating units, crates, yokes, and baskets) for pickling departments.

James I. Minteer was promoted to the post of secretary of Stewart-Warner Corporation. Minteer had been assistant secretary and assistant treasurer since 1943, and his appointment filled the vacancy created by the death of **A. R. Benson** on July 31.

Minteer joined Stewart-Warner in 1942 as fiscal agent of the Green River Ordnance Plant, Amboy, Illinois, government munitions plant operated by Stewart-Warner during the war. Prior to 1942 Minteer maintained his own mortgage, real estate and insurance business in Chicago, following several years of banking work as trust department manager and subsequent bank liquidation duties for the Illinois State Auditor.

Gustave R. Geiger was appointed supervisor of quality control of SKF Industries, Incorporated, main plant. Geiger will be responsible for the establishment of procedures and the maintenance of product standards in the manufacture of anti-friction bearings which were inaugurated in 1943. Associated with SKF since



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1941, Geiger is an honor graduate of Drexel Institute of Technology. He succeeds **Gustave A. Johnson,** a veteran of 27 years of service, who has been appointed night superintendent of the company's main plant.

Dr. Carl F. Prutton, formerly head of the department of chemistry and chemical engineering at Case School of Applied Science, has joined Mathieson Chemical Corporation as director of research. He will have headquarters in Mathieson's executive offices in New York and at the research laboratories in Niagara Falls.

Dr. Prutton was a faculty member at Case from the time of his graduation from that school in 1920 until 1948. He was a consultant to the Lubrizol Corporation from 1928 until he joined Mathieson and a consultant to The Dow Chemical Company from 1928 until 1941. From 1942 to 1944 he served as chief of the process development branch of the office of rubber director and was also consultant to the War Production Board.

Lester B. Hammersley has been appointed sales promotion manager by Firth Sterling Steel and Carbide Corporation, with headquarters at McKeesport, Pennsylvania. Mr. Hammersley was formerly assistant sales manager of Signode Steel Strapping Company of Chicago and previously division manager of Fairbanks Morse and Company.

Jack R. Gregson was made district sales manager of the bucket department of the Wellman Engineering Company in the eastern territory, with offices at No. 2612 Graybar Building, 420 Lexington Avenue, New York, New York.

Mr. Gregson is a graduate of the College of Engineering, Duke University, and was formerly sales engineer for the Lima Shovel and Crane division, Lima Locomotive works in the eastern territory, and assistant director of foreign operations of the Lima Shovel and Crane division, Lima-Hamilton Corporation.

R. B. Jenner was appointed head of the Harbison-Walker's refractory plastics and castables division. Associated with Harbison-Walker since 1944, Mr. Jenner was previously connected with Briggs Manufacturing Company, United Engineers and Constructors, Inc., and more recently with Cities Service Oil Company. He was serving with the Boston sales office of Harbison-Walker at the time of his recent appointment.

Forrest E. Allen, formerly a member of the faculty of Iowa State College in the department of mechanical engineering, and associate professor in charge of the instruction on metallurgy, has joined the development and research division of the International Nickel Company, Incorporated. He will make his headquarters at New York and will work on the company's educational program with universities and colleges in the United States. Mr. Allen has had considerable practical and consulting experience during his association with Iowa State College in the past nine years. He received a B.S. degree in mechanical engineering from Michigan State College in 1936 and an M.S. degree in mechanical engineering from the University of Michigan in 1939.

William H. Starbuck has been appointed assistant general sales manager of the Kellogg division of the American Brake Shoe Company. Mr. Starbuck, formerly representative, has served in various sales capacities since first joining the company. A native of Cleveland, Ohio, he attended Kent School and Yale Univer-

sity. He will be located at the division's headquarters in Rochester, New York.

Charles A. Kral has been appointed assistant general manager of operations for the Newport Rolling Mills, a division of International Detrola Corporation, effective October 4, 1948. The Newport Rolling Mills are going through a period of modernization and expansion.

CHARLES A. KRAL

Mr. Kral's former position was assistant general superintendent for the Jones and Laughlin Steel Corporation at their Aliquippa works where he has been employed for the past eleven years. Prior to his association with Jones and Laughlin, he was assistant general manager of Wheeling Steel Corporation, Steubenville, Ohio.

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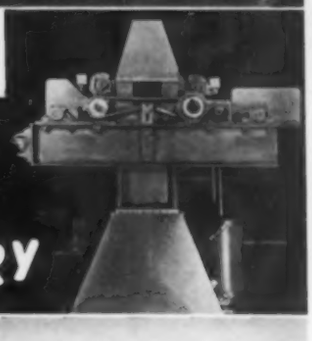

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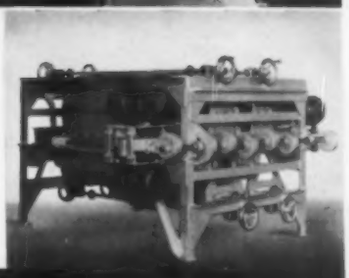

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Sherrill S. Deputy, assistant sales manager of American Wheelabrator and Equipment Corporation, Mishawaka, Indiana, since 1946, has recently been appointed sales manager of the company. Prior to his association with American Wheelabrator and Equipment Corporation, Mr. Deputy spent eighteen years with International Business Machines, Incorporated, in various sales and administrative positions.

Gerald T. Haddock has been appointed American sales representative of Lafarge Aluminus Cement Company, Limited, London, England. Mr. Haddock, who will handle sales of Ciment Fondu Lafarge in the United States, was recently sales promotion manager, Lumnite division, Universal Atlas Cement Company. He held a similar position with the former Atlas Lumnite Cement Company and has been associated with the cement industry since his first connection with the Portland Cement Association in 1924. Mr. Haddock is establishing headquarters in New York City.

Fred R. Wilson retired recently as manager of material department of Fort Pitt Bridge Works' Canonsburg plant. He has served the company for forty-nine years. Succeding Mr. Wilson is **John C. Ingram**, formerly assistant manager of the material department.

W. F. Godejohn was named as assistant to the president, Harbison-Walker Refractories Company. For many years, Mr. Godejohn was engaged in the refractories industry in the St. Louis area and he is widely experienced in the refractories industry in mining, manufacturing and administrative work. Mr. Godejohn was formerly Missouri district superintendent of Harbison-Walker with jurisdiction over the Vandalia and Fulton Works.

J. Norman Quinlan was named assistant to general superintendent of Gary, Indiana, works of Carnegie-Illinois Steel Corporation. Quinlan has been associated with the plant since 1907. He has been associated with the west mills which include the numerous merchant mills, since 1938, when he became assistant division superintendent. He has been a division superintendent for the last eight years.

Charles J. Hunter succeeds J. Norman Quinlan as division superintendent of the west mills, Carnegie-Illinois Steel Corporation, Gary, Indiana. He has bachelor's and master's degrees in metallurgical engineering from the Case School of Applied Science. He joined Carnegie-Illinois Steel Corporation in 1935 as a metallurgist in the Pittsburgh district and during the war he served as co-ordinator of armor plate products for the entire subsidiary company. He joined the Gary works organization in 1944 as chief metallurgist and three years later also became chief inspector.

Oscar Pearson succeeds Charles J. Hunter as chief metallurgist and inspector of Carnegie-Illinois Steel Corporation, Gary, Indiana. He is a mining engineering graduate of the University of Alabama. He has been associated with the corporation since 1928, starting at the Ensley, Alabama, plant of the subsidiary Tennessee Coal Iron and Railroad Company. He joined Gary works seven years ago as assistant to chief metallurgist and has been assistant superintendent of steel production and also assistant to division superintendent of steel production and central mills before assuming his new duties.

Ragnar Overberg succeeds Oscar Pearson as assistant in steel production and central mills Carnegie-Illinois Steel Corporation, Gary, Indiana. He is a native of Nordmark, Sweden, and has metallurgical and mining degrees from the Filipstad School of Metallurgy in Sweden. He had metallurgical experience in Sweden before coming to the United States. He joined Gary works in 1925 and has since progressed through various metallurgical and steel production executive positions.

Obituaries

Emil R. Gasser, chief physicist of Farrel-Birmingham Company, Incorporated, died suddenly, September 5, at his home in Buffalo, New York.

Mr. Gasser was first employed by Farrel-Birmingham in 1928 and, for the past three years, was director of research activities with headquarters at the laboratory of the company's Buffalo, New York plant. For his work in development of propulsion gearing and related

EMIL R. GASSER

design during World War II, Mr. Gasser was awarded a citation by the Navy Department.

Mr. Gasser was born and reared in Switzerland and his death occurred only a week after his return from an extended visit to that country. He was educated in schools in Schaffhausen and Zurich and he first came to the United States in 1925, locating in Buffalo.

Henry J. Litsey, general superintendent of the Ambridge plant, Spang Chalfant division of the National Supply Company, died September 16 at the age of 57. Mr. Litsey, whose home was in Edgeworth, Pennsylvania, had been employed at the plant for 31 years and had been general superintendent since 1943. He attended Harrodsburg Academy and the University of Kentucky.

Frank A. Wiley, who, prior to his retirement in 1939, was electrical engineer at Wisconsin Steel Works of International Harvester Company, died September 15, at the age of 76.

After some years with Deering Harvester Company, Mr. Wiley entered the employ of Wisconsin Steel Company in 1902, as chief electrician. In 1923 he was made electrical engineer of the company, which had meanwhile become a subsidiary of International Harvester. He was responsible for maintenance of electrical equip-

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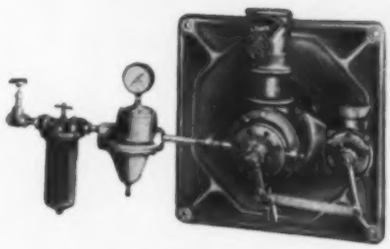

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ment in this plant, as well as for the design and installation of all new electrical installations.

Mr. Wiley was very active in Association affairs, having been a member almost since its inception. He served as chairman of the Chicago District Section in the early

FRANK A. WILEY

days of the section's history, and he was a member of the Association's safety committee that arranged the historic cooperative safety congress at Milwaukee, Wisconsin, at which the National Safety Council was conceived.

Newman Ebersole, director of purchases of Armco Steel Corporation, and widely known in industry, died September 22 in Cincinnati, Ohio. He had been a patient in Holmes Hospital for about three weeks, and had undergone several operations. A graduate of Cornell University in 1910, Mr. Ebersole first became associated with Armco in 1911, as a weighmaster in the bar mill. Later, he was promoted to assistant to purchasing agent and in 1937 was named general purchasing agent. He was advanced to the position of director of purchases in 1944.

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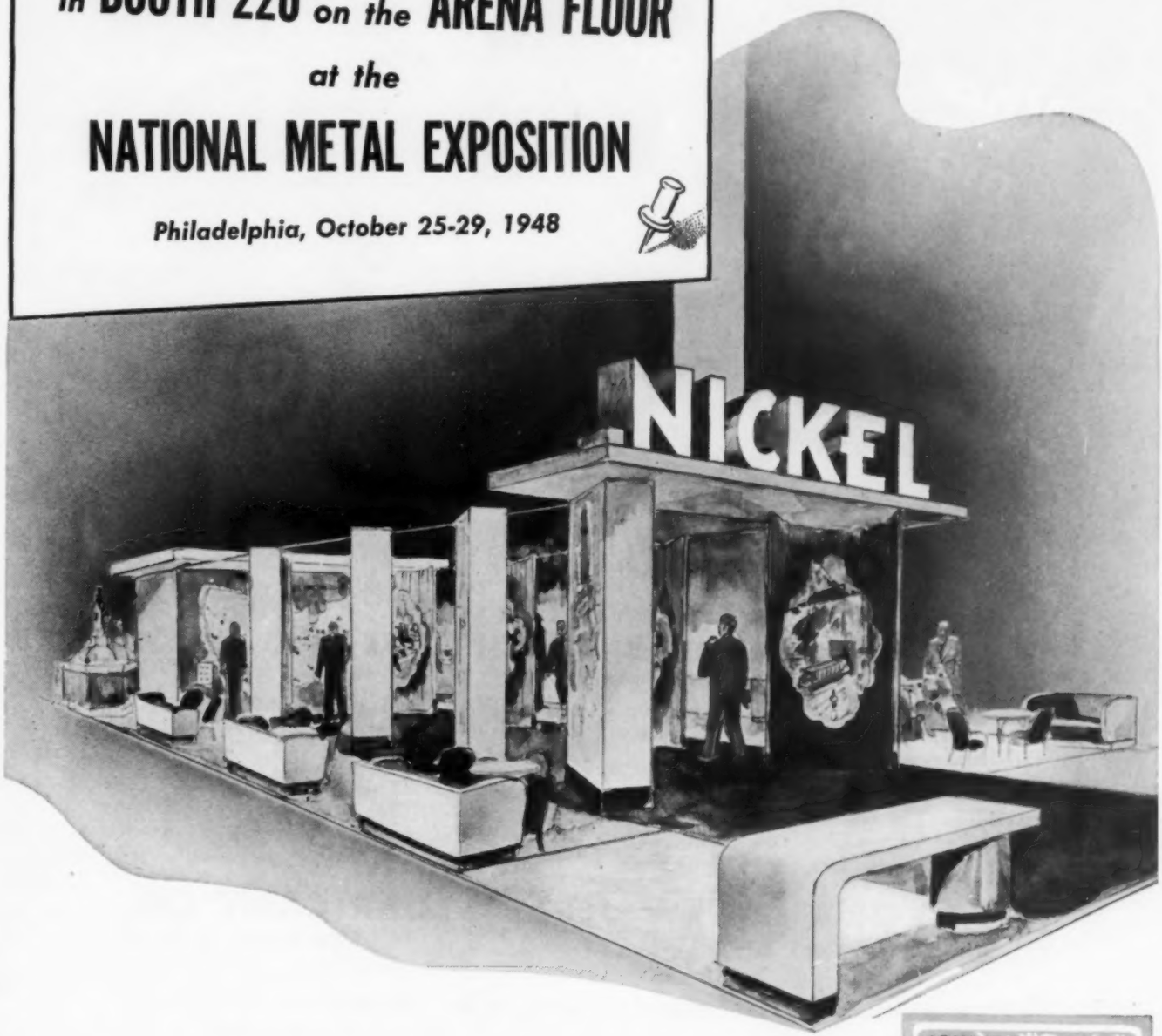
Philadelphia, October 25-29, 1948



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No. 1773*

SEE THE 1773 SLITTER AT BOOTH 632 NATIONAL METAL EXPOSITION, OCT. 25-29, PHILADELPHIA, PENN.

In the field of warehouse metal slitting, a compact, smoothly running, well-guarded slitter is required, which above all may be quickly set up to produce any desired combination of cuts on any gauge of metal within its range.

Torrington's 60 years experience in designing and building auxiliary mill equipment has been applied in the development of these slitters to especially meet warehouse requirements. Their simplified design permits rapid adjustment and assures fast, accurate runs. Their enthusiastic reception has permitted large production which enables us to offer them in the low price field. A larger sized slitter No. 1778 (not shown) has a capacity of 5 cuts of .110″ non-ferrous metal, or .093″ mild steel, or equivalent, built for 12″, 18″ or 24″ maximum widths.

Detailed specifications and quotation will be furnished upon request.

The 1773 Warehouse Type Metal Slitting Machine is a compact unit. The housings, payoff, winder and motor drive are all mounted on a single welded steel base, reducing floor space to approximately 4′ x 6′.

STANDARD CAPACITY — 5 cuts (4 strips) .080″ non-ferrous or .062″ mild steel maximum thickness, or an equivalent number of additional cuts in thinner gauges up to 12″ or 18″ maximum trimmed width respectively. Recommended minimum thickness .010″. Maximum O.D. of coil 20″; maximum weight of coil, 400 lbs. Special supports for heavier coils can be supplied.

SPEED — 150 F. P. M.

CUTTERS AND CUTTER ARBORS — Cutters (separately quoted) are 5½″ diameter, of either alloy tool steel or hi-carbon, hi-chrome steel. Arbors are of steel, 2⅝″ diameter, with ½″ x ½″ key.

ADJUSTMENTS — An exclusive feature is a manual adjustment of the top arbor to compensate for wearing down of the cutters. Simple, manually operated spur gears rotate the eccentric arbor bushing at each housing, providing a total adjustment of 9/16″.

GUIDE TABLE — At entry has adjustable side guides, wood wipers with spring to exert tension on the metal, and idle guide roller. 40″ metal line.

WINDER — At exit consists of a 2¾″ diameter winding arbor fitted with 3/32″ slot and handwheel for starting strips. Recommended maximum material thickness on 2¾″ diameter arbor is .062″.

SEPARATOR DISCS — (separately quoted) Hardened and tempered spring steel .055″ — .050″ thick and 14″ or 20″ diameter.

DRIVE — Standard make motor, 5 H.P., 1800 R.P.M. Drive to winder through Link leather belt.

*The number "1773" indicates that this is the one thousand seven hundred and seventy-third complete and original design planned on the drafting boards of the Torrington Manufacturing Company. The number of machines built for the metal mills is many times that figure.

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A-B-K Laminated Plastic Bearings

Cut Costs 4 Ways

A-B-K roller neck bearing with separate collar.
A-B-K patented reinforced edge slipper bearing, made to specified blueprint sizes.
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2. Reduce Power Consumption
3. Eliminate Lubricating Oil
4. Require Fewer Adjustments

Steel mill records clearly prove that when metallic bearings are replaced with A-B-K Laminated Plastic Bearings, production goes *up* and costs come *down*. Specifically, A-B-K bearings cut costs four ways:

Outwear metallic bearings—A-B-K laminated bearing material is extremely tough and slow-wearing. It is impervious to mild acids and alkalies, will not distort under shock and withstands temperatures up to 200° F. without failure. In actual service, A-B-K bearings customarily outwear metal several times.

Reduce power consumption—A-B-K Laminated Plastic Bearings have an exceptionally low coefficient of friction which produces remarkable savings in power. The A-B-K surface is self-renewing—actually polishes, but never scores, the shaft.

Eliminate lubricating oil—A-B-K bearings are successfully lubricated with *water*. Cost of oil or grease is eliminated entirely.

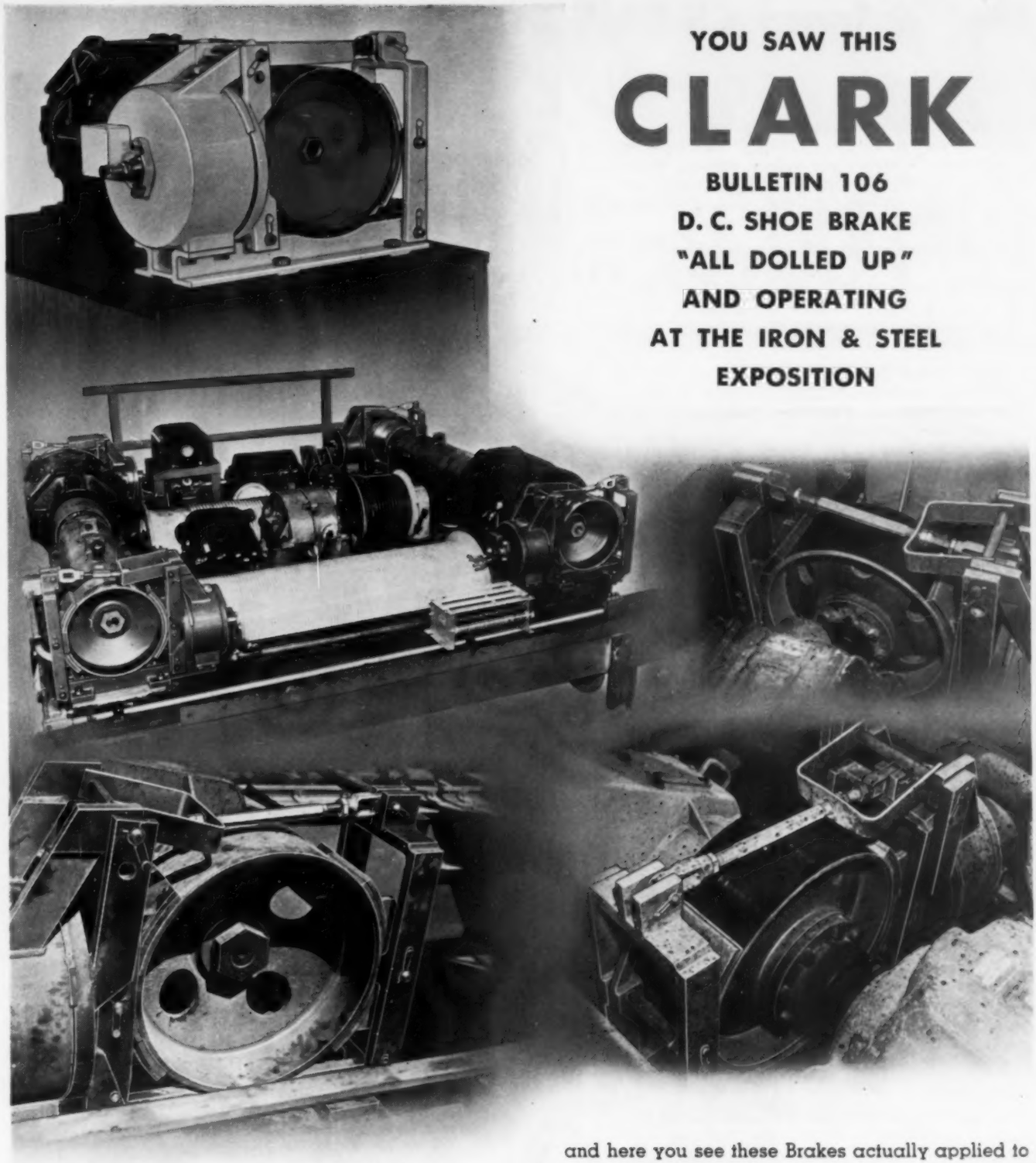
Require fewer adjustments—Because A-B-K bearings hold gauge longer, oversize requirements and need for roll adjustments are sharply reduced. This means fewer shutdowns—a higher percentage of productive time from each A-B-K equipped unit.

It will pay you to investigate fully the cost-cutting advantages of A-B-K Laminated Plastic Bearings for your mill. The complete engineering and research facilities of American Brakeblok are at your disposal. Write to arrange a consultation.

AMERICAN Brake Shoe COMPANY

AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN

A-B-K
Laminated Plastic Bearings



YOU SAW THIS

CLARK

BULLETIN 106
D. C. SHOE BRAKE
"ALL DOLLED UP"
AND OPERATING
AT THE IRON & STEEL
EXPOSITION

and here you see these Brakes actually applied to one of the toughest jobs in a steel mill—a skull cracker crane. Exposed to all kinds of weather with no protection, these Brakes operate efficiently.

And as we've said before, "And the only adjustment is on top, where you can see it, etc., etc."

CONSULT YOUR NEAREST
CLARK
REPRESENTATIVE ON
YOUR BRAKE PROBLEMS

THE CLARK CONTROLLER CO.

EVERYTHING UNDER CONTROL • 1146 EAST 152nd STREET, CLEVELAND 10, OHIO

Get it from CRANE . . .
for quality in every piping item

It's as simple as that! *Everything* from Crane is the easy way to specify "Quality" in all piping equipment. Whether it's valves, fittings, accessories or fabricated piping . . . one catalog and one order quickly bring everything you need from your nearest Crane Branch.

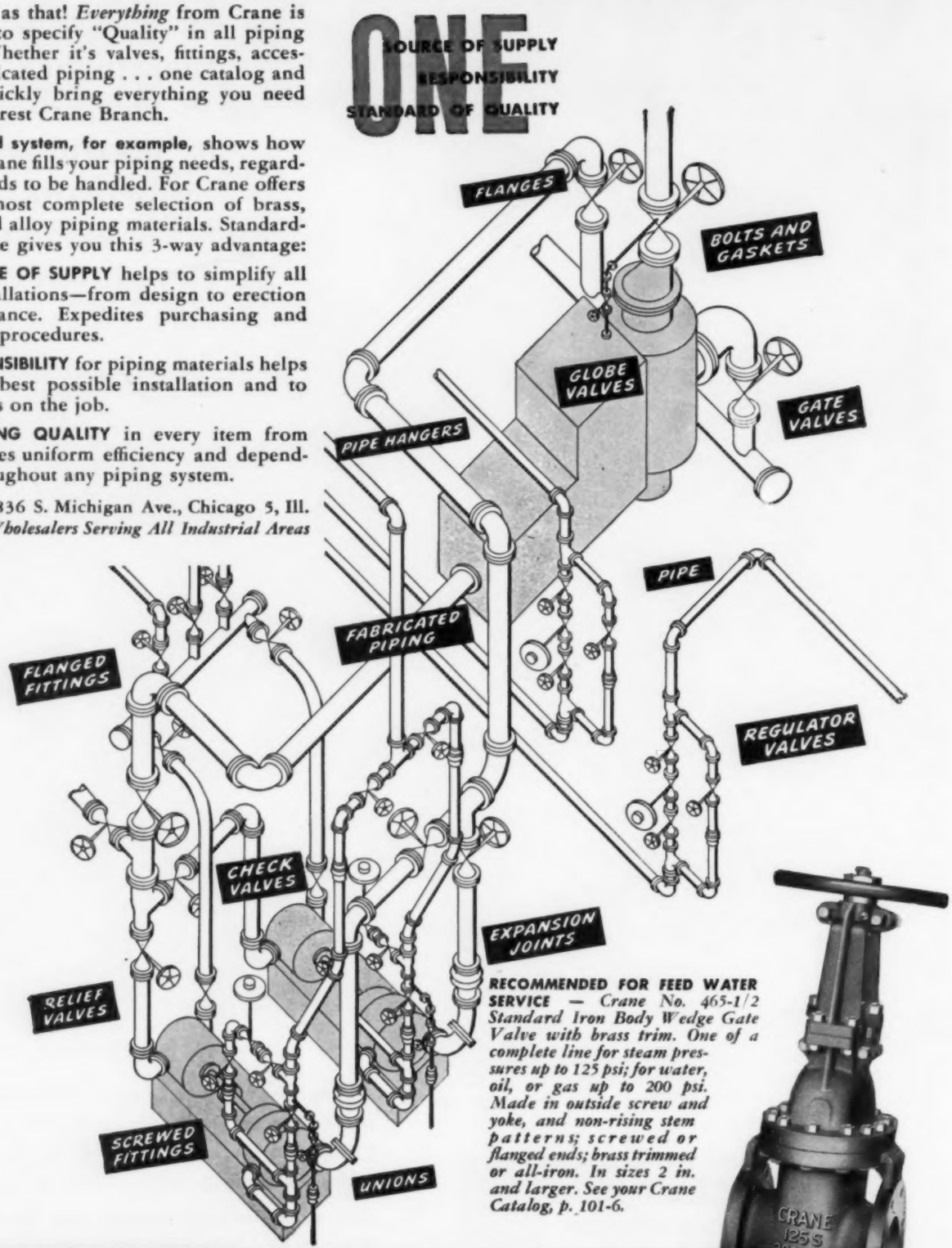
This boiler feed system, for example, shows how completely Crane fills your piping needs, regardless of the fluids to be handled. For Crane offers the world's most complete selection of brass, iron, steel and alloy piping materials. Standardizing on Crane gives you this 3-way advantage:

ONE SOURCE OF SUPPLY helps to simplify all piping installations—from design to erection to maintenance. Expedites purchasing and store-room procedures.

ONE RESPONSIBILITY for piping materials helps to get the best possible installation and to avoid delays on the job.

OUTSTANDING QUALITY in every item from Crane assures uniform efficiency and dependability throughout any piping system.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



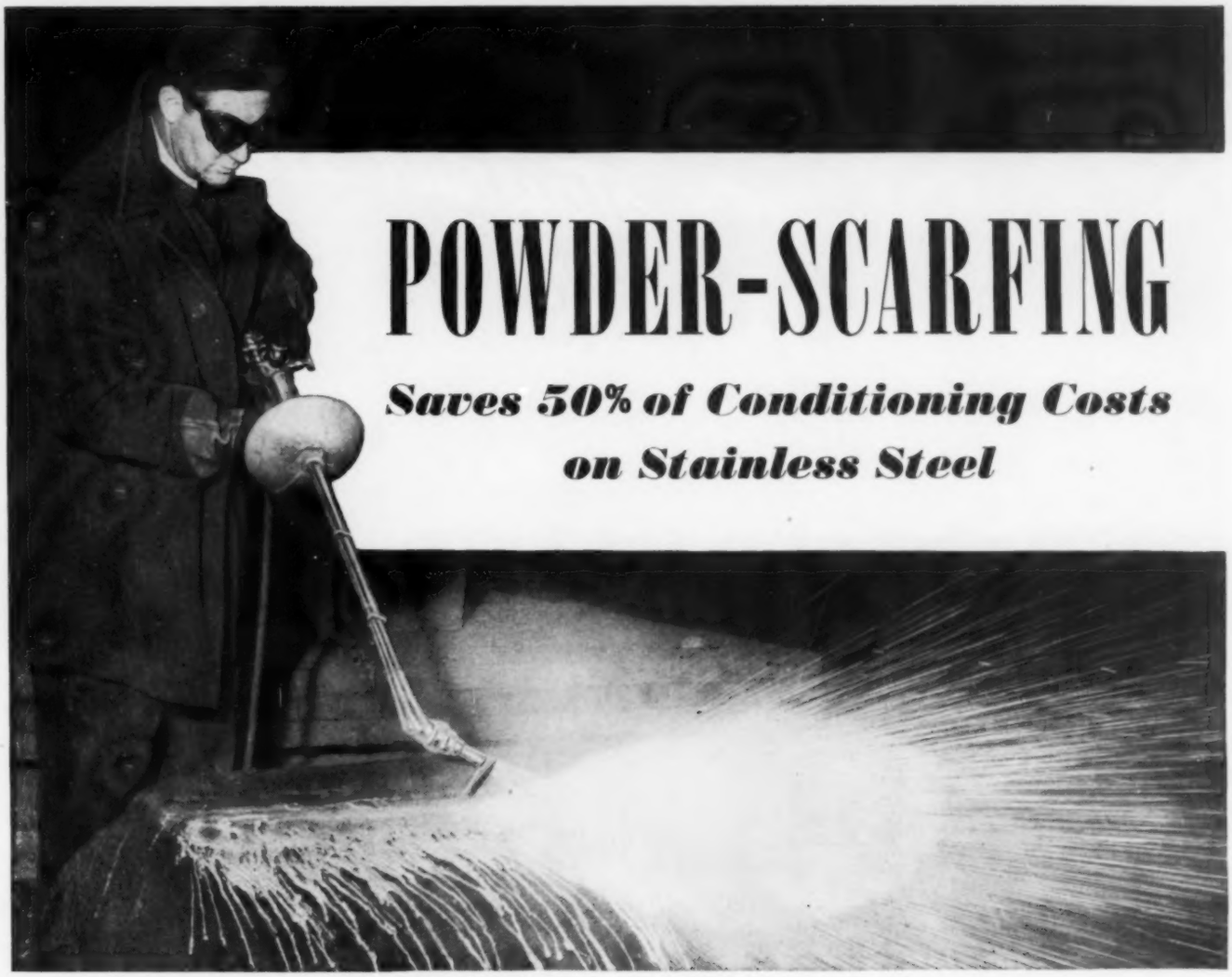
RECOMMENDED FOR FEED WATER SERVICE — *Crane No. 465-1/2 Standard Iron Body Wedge Gate Valve with brass trim. One of a complete line for steam pressures up to 125 psi; for water, oil, or gas up to 200 psi. Made in outside screw and yoke, and non-rising stem patterns; screwed or flanged ends; brass trimmed or all-iron. In sizes 2 in. and larger. See your Crane Catalog, p. 101-6.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM



POWDER-SCARFING

Saves 50% of Conditioning Costs on Stainless Steel

Here, a 3-ton ingot is being powder-scarfed, at a rate of 12 to 14 feet per minute.

LINDE's powder processes can save thousands of dollars a week in stainless steel production at your mill. To remove all the cracks and other defects that might occur in rolling a 12,000-lb. ingot would take about 48 hours by grinding. LINDE's powder-scarfing process makes the job easy . . . cuts the time to 4 to 6 hours. A heat of 22 to 24 1,000-lb. ingots can be powder-scarfed, using two blowpipes, in only one eight-hour shift—and at one-half the cost!

Scarfing will show up any imperfections; small cracks are never "smeared over."

Powder-cutting also speeds scrapping of stainless steel . . . hot tops can be removed from large ingots or bloomed ingots in a minimum of time . . . stainless steel slabs with cracked edges can be saved by cutting out the defects. Stainless steel plate can be easily cut to customer's specification.

LINDE's service engineers are always available to help in solving problems of treating, cutting, joining, and forming metals. Phone or write the nearest LINDE office.

Linde

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd St., New York, N. Y. Offices in Other Principal Cities
In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto

The word "Linde" is a registered trade-mark of The Linde Air Products Company

standardize on...

PYLETS

A Modern Line of Improved Heavy-Duty Conduit Fittings

PYLET PRACTICAL DESIGN FEATURES

Accurate, malleable iron castings made in Pyle-National's own foundry. Double weather-proof protection—first, galvanized, and then finished with baked sprayed aluminum.

Smooth interiors, round edges and large wiring spaces prevent damage to wires. Ribbed sidewalls provide extra strength.

Strong Domed Covers are warped and Body Cover Joints are ground flat for tight gasket seal. Heavy hub sections of ample cross section are tapped straight and true with accurate, cleancut, TAPERED threads.

Dowl-pin type self retaining screws provide easy alignment of covers—hold cover and gasket together during handling.

A Full Range of Types and Sizes for Industrial Wiring

1

2

3

4

5

1. FS AND FD PYLETS AND COVERS—1, 2, 3 and 4 gang, square corner types, take all standard switch and receptacle plates.

2. ROUND BASE PYLETS AND COVERS—Ideal for Vaportight junction boxes—Flush and surface mounting. Take standard 4-inch outlet box cover; also vaportight fixtures, plug receptacles and Flexible fixture hangers.

3. VAPORTIGHT LIGHTING FIXTURES—With heavy cast metal bases, weathertight sealing and sturdy guards. Complete line, for 10 to 200 watt lamps, for conduit or wall mounting, universal 4 and 5 hub types, two and three gang, handrail and outlet box types, also midget fixtures.

4. FLEXIBLE FIXTURE HANGER PYLETS—Universal joint hub allows easy removal of fixture, free swing movement of fixture with stop to prevent wire injury, also cushion type for protection against vibration. Also rectangular Pylets with suspension hanger.

5. CAST METAL SAFETY SWITCHES AND CIRCUIT BREAKER PYLETS—Heavy duty safety switches and fuse boxes with or without plug receptacles and circuit breaker Pylets with all features for reliable service under severe conditions. Safety switches have quick make and break, interlocked cover and weathertight gaskets on both cover and hub plates. Available with interlocking plug receptacles.

Refer to your Pylet Catalog 1100 for complete listings including plugs and receptacles—explosion-proof pylets, cord and cable grips—flexible conduit couplings—unions—reducers—elbows and grip handles—portable hand lamps.

THE PYLE-NATIONAL COMPANY

1370 NORTH KOSTNER AVENUE, CHICAGO 51, ILLINOIS

Offices: New York • Baltimore • Pittsburgh • St. Louis • San Francisco • St. Paul • Cleveland
Export Department: International Railway Supply Co., New York
Canadian Agent: The Holden Co., Ltd., Montreal

SINCE 1897

PLUGS and RECEPTACLES • FLOODLIGHTS • TURBO-GENERATORS • LOCOMOTIVE HEADLIGHTS • MULTI-VENT AIR DISTRIBUTION

everywhere in the **STEEL INDUSTRY---**

Hagan Ring Balance Flow Meters

HAGAN HALL BUROMIN CALGON

Hagan Ring Balance Flow Meters are in use in steel plants in all parts of the country. They are measuring air and oxygen; water and steam; natural gas, coke oven gas, blast furnace gas; tar, wash oil, ammonia, sulphuric acid, and many other liquids.

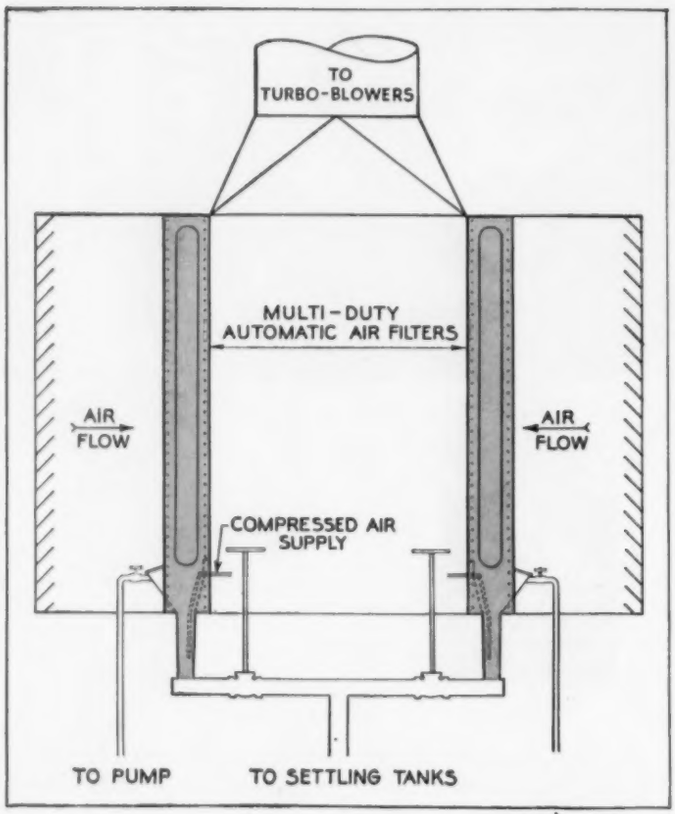
They are operating at static pressures as low as ½ p.s.i. and as high as 1600 p.s.i.; on lines from 1½ inches to 48 inches in diameter. They are metering steam flows from 6,000 to 200,000 pounds per hour; liquid flows from 3,000 gallons per hour or less up to 250,000 gallons per hour; gas flows as high as 2,000,000 cubic feet per hour and air flows of 6,000,000 cubic feet per hour.

Hagan Ring Balance Flow Meters are used in these applications because they have features found in *no other meter*. For full information on them, write for Hagan Bulletin 2M48. Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

Filter the air and you can forget impeller blade erosion



YOU'VE got a maintenance problem in the making when you feed a turbo-blower raw air. The seemingly harmless particles of dust and dirt it contains become killers when they enter a high speed, rotary blower—and rapid wear and erosion of the impeller is the costly end result.

Scores of mills have solved this problem economically with the installation of AAF Multi-Duty Air Filters at the blower intake. Diagram at left shows a typical installation in which provision has also been made for quickly changing and cleaning the filter's oil bath.

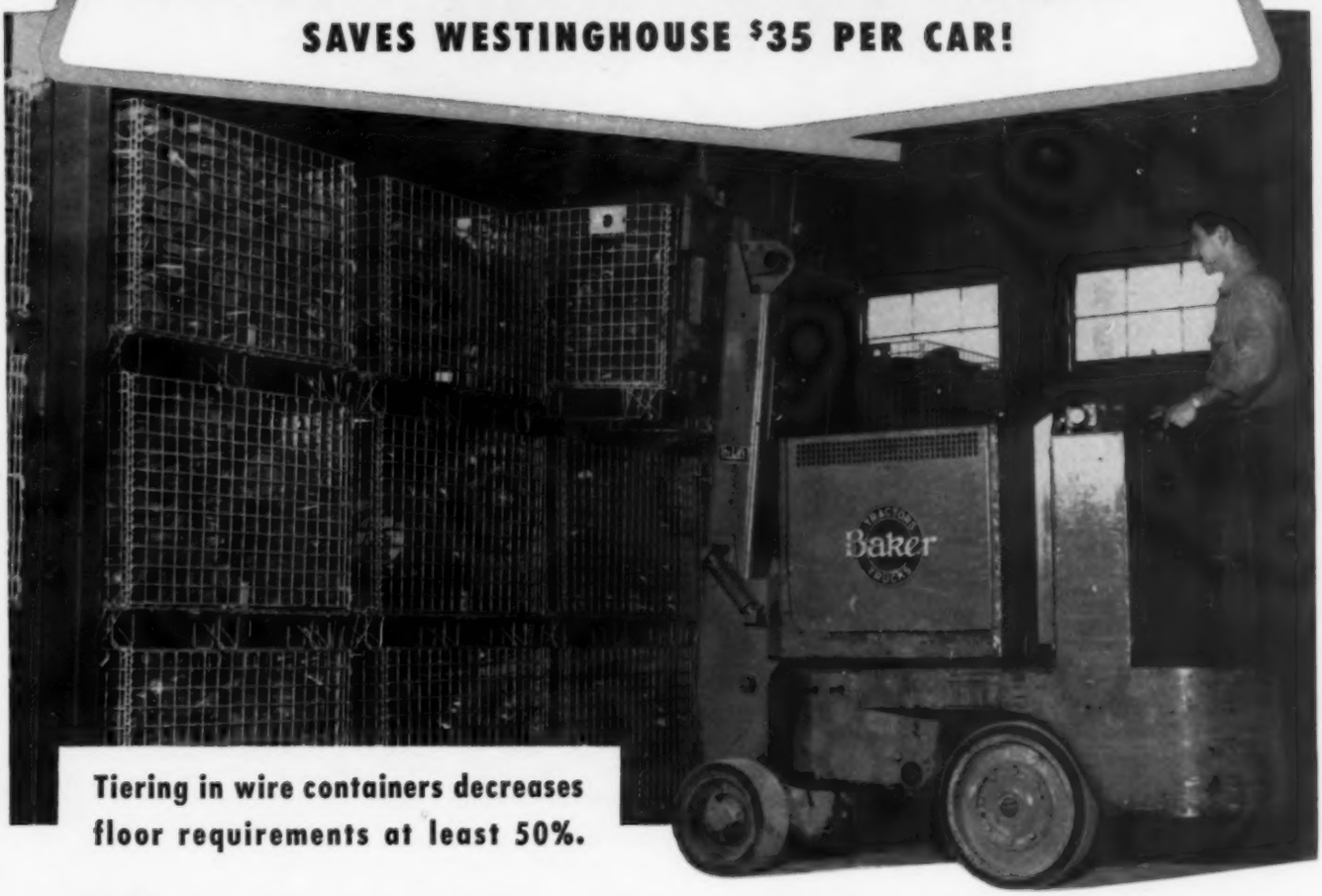
The AAF Multi-Duty is an automatic self-cleaning air filter. Overlapping panel construction of the filter curtain combines positive self-cleaning and high efficiency air cleaning as integral functions of the operating cycle. Uniformly constant air supply is assured as operating resistance remains fixed when once established for a given dust concentration.

Here's one more opportunity to eliminate a possible source of shutdowns and costly repairs. For complete information on Multi-Duty's record in turbo-blower service, call your local AAF representative or write direct to—

THE AMERICAN AIR FILTER COMPANY, INC.
302 Central Avenue, Louisville 8, Ky.
In Canada: Darling Bros., Ltd., Montreal, P. Q.

AAF
AIR FILTERS
AND ELECTRONIC PRECIPITATORS

UNLOADING CASTINGS WITH *BAKER TRUCK* SAVES WESTINGHOUSE $35 PER CAR!



Tiering in wire containers decreases floor requirements at least 50%.

BAKER Articulated Fork Trucks, used with collapsible wire containers, have reduced a 48 hour unloading operation to 3½ hours. Bracket castings formerly arrived at the Lima Westinghouse plant piled loose in the car, were placed in rigid skid boxes, one at a time, carried to storage, and piled, one at a time in wooden bins. When needed, they were again placed in skid boxes, one at a time, and taken to production.

Today they arrive from the foundry in the wire containers. The Baker Truck unloads, stores, and carries them to production *in the same containers*. Empty containers are collapsed and returned to supplier.

Additional benefits are

1. **Easier handling for supplier.**
2. **Demurrage on carriers eliminated.**
3. **Breakage at receiving end eliminated.**
4. **Floor storage requirements cut 50%.**
5. **Inventory taking in storage facilitated.**
6. **Production speeded by**
   a. **Avoiding delays in delivery of work.**
   b. **Work positioned to minimize re-handling.**
   c. **Cutting waiting time between jobs.**

The Baker Articulated Truck is ideally suited to this plant's needs, since it operates without difficulty in narrow aisles in storage, and in congested areas in production departments.

BAKER INDUSTRIAL TRUCK DIVISION *of The Baker-Raulang Company*
2166 West 25th Street • Cleveland 13, Ohio
In Canada: Railway and Power Engineering Corporation, Ltd.

See us at Booths 608B and 609, 3rd National Materials Handling Exposition Philadelphia, January 10-14, 1949.

Baker INDUSTRIAL TRUCKS

CRESCENT PALLETIER FORK TRUCK

CRESCENT PALLETIER FORK TRUCK

Battery Electric Trucks and EXIDE-IRONCLAD® BATTERIES

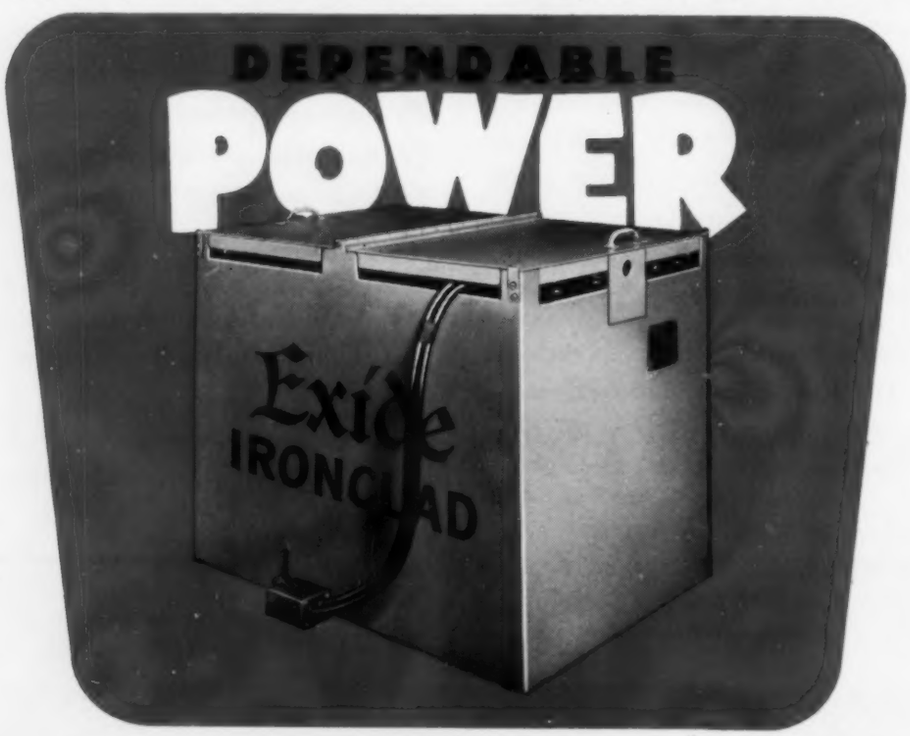
Help to lower production costs . . .

Mechanized materials handling, with battery electric trucks, is one solution to high production costs. By this modern, efficient method materials are moved in greater volume, and at a big saving of time, effort and handling costs.

America's top industries prefer battery electric trucks because, when *all* costs are added up, they show the *lowest cost per ton handled*. And you can count on maximum safety and dependability, with full shift availability, when the motive power is supplied by Exide-Ironclad Batteries.

Electric industrial truck users have frequently expressed a preference for Exide-Ironclad Batteries, the batteries that assure peak performance day after day. This preference is due to the fact that Exide-Ironclad Batteries have ALL FOUR of the vital characteristics of a storage battery—high power ability, high electrical efficiency, ruggedness and long life.

Write for further particulars and FREE copy of Exide-Ironclad Topics, which covers latest developments in materials handling and shows actual case histories.



1888 . . . Dependable Batteries for 60 Years . . . 1948

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • *Exide Batteries of Canada, Limited, Toronto*

More
ILSON RADIANT CONVECTOR FURNACES
ILSON RADIANT CONVECTOR FURN
RADIANT CONVECTOR FURNACE
in Action!
As a steel mill operator, do you know what convection annealing means to you?
The Lee Wilson Engineering Company, Inc., developed this system of heat application to coiled strip and tin plate.
Each furnace of this type will anneal 2½ times the amount of steel coils that older types of equipment produce, and cool the charges in approximately the same time as required for heating.
Only your own desire for better production at lower costs limits what the Lee Wilson radiant convector annealing system can do for you.
ENGINEERING Co., Inc.
Lee Wilson
ILSON CONVECTION HEATING FOR COILED STEEL ANNEALING

CRESCENT PALLETIER FORK TRUCK

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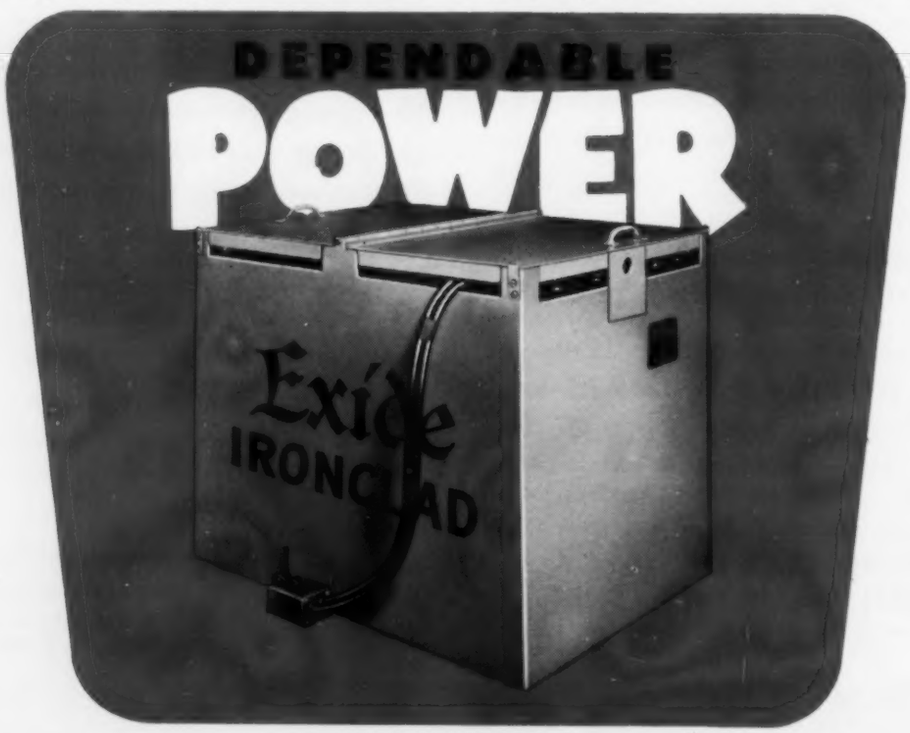

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Only your own desire for better production at lower costs limits what the Lee Wilson radiant convector annealing system can do for you.
Lee Wilson
ENGINEERING Co., Inc.
ILSON CONVECTION HEATING FOR COILED STEEL ANNEALING

"BE KIND TO INGOTS" DAY

Comes Every Day in C. F. & I's New Pits

Micromax Control on Salem Pits Helps Accurate, Economical Heating

It's the ingot that matters in soaking pit operation! Salem Engineering Co. is thinking about ingot quality when they design and install a 24-pit battery like this, and recommend controls to regulate operation. Colorado Fuel & Iron Corp. is planning the future of ingots and ingot products when they decide on temperature cycles and set up operating procedures.

These planners have assigned Micromax Controllers to help protect the "interests" of the ingots during the long soaking period. Micromax gives this protection from several angles. Of course, it doles out fuel, in exactly varied amounts to heat the great chunks of steel accurately and uniformly. It preserves correct temperatures, despite the effects of charging, pulling and changes in ambient conditions. But Micromax is also tied into the regulation of combustion and furnace pressure, so that these conditions are held firmly in line during the necessary adjustments of heating rate and soak temperature. Result — every day is "Be Kind to Ingots" Day in the pits, and *the rolling mill is sure of a constant supply of ingots properly conditioned for processing.*

Leeds & Northrup Co., 4942 Stenton Ave., Philadelphia 44, Pa.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Irl. Ad N-33-667(1)

Wagner Motors on the job . . .

A Wagner 100-hp type RP motor installed on a large vertical-type Worthington compressor.

Tough Going...Day after Day

BUT WAGNER MOTORS CAN TAKE IT!

Motors that drive pumps and compressors find the going tough. They must overcome back pressures set up by fluids and gases—they are often required to make repeated starts and stops—they are sometimes kept in continuous service.

But Wagner Motors can take it. There is a motor correctly engineered to meet the requirements of every type of pump or compressor in the wide variety of types and sizes of motors in the Wagner line. More than fifty-five years of motor experience stands behind every motor bearing the Wagner name . . . and every motor built by Wagner reflects the value of this experience!

Twenty-nine sales and service branches, in principal cities, are ready to help you on any motor problem. Bulletin MU-185 will give information on the complete line of Wagner Motors.

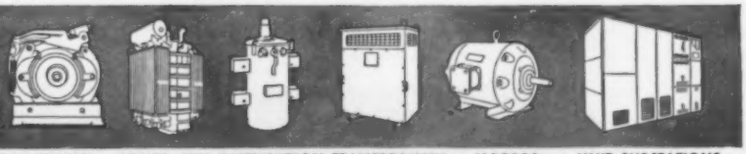
Regardless of what your motor requirements may be—large motors . . . small motors . . . Wagner makes them all. Choose a Wagner motor for your next installation.

Wagner Electric Corporation

6483 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.

Consult Wagner Engineers on all Electric Motor Problems

Wagner Electric Corporation EST. WE 1891



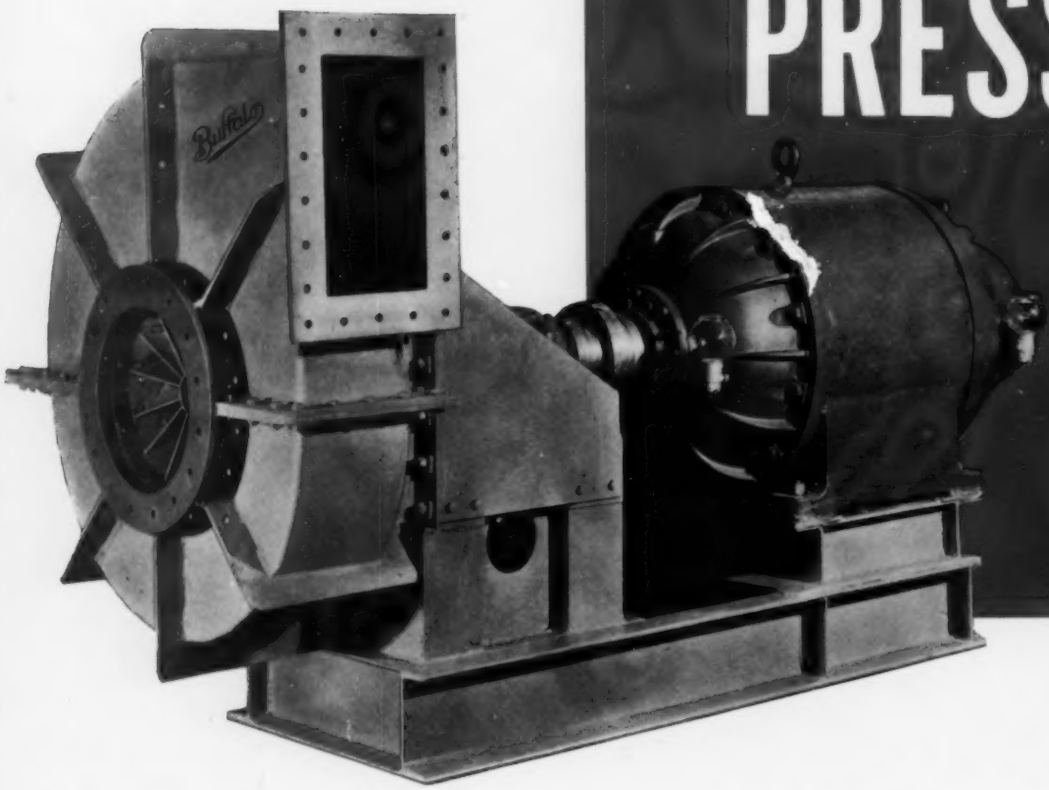
BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL AND AUTOMOTIVE PRODUCTS

M48-17

BUILT FOR THE TOUGH

PRESSURE JOBS



"BUFFALO" PRESSURE BLOWERS

Need single stage blowing up to 4 lbs. per square inch? Up to 75,000 cfm? Under rigorous service and pressure conditions? Then simply write us for Bulletin 3553 — see how the rugged, efficient rotors and air-tight, stiffened side plates and housings in "CB" and "CC" Blowers give you the kind of service you want with minimum maintenance.

What is your air pressure need? There is a "Buffalo" Blower built for it. The "CC" Compressor above handles 7200 cfm at 315°. Heavy ribbed casing is horizontally split with center line support — housing air-tight at 15 pounds internal pressure.

BUFFALO FORGE COMPANY

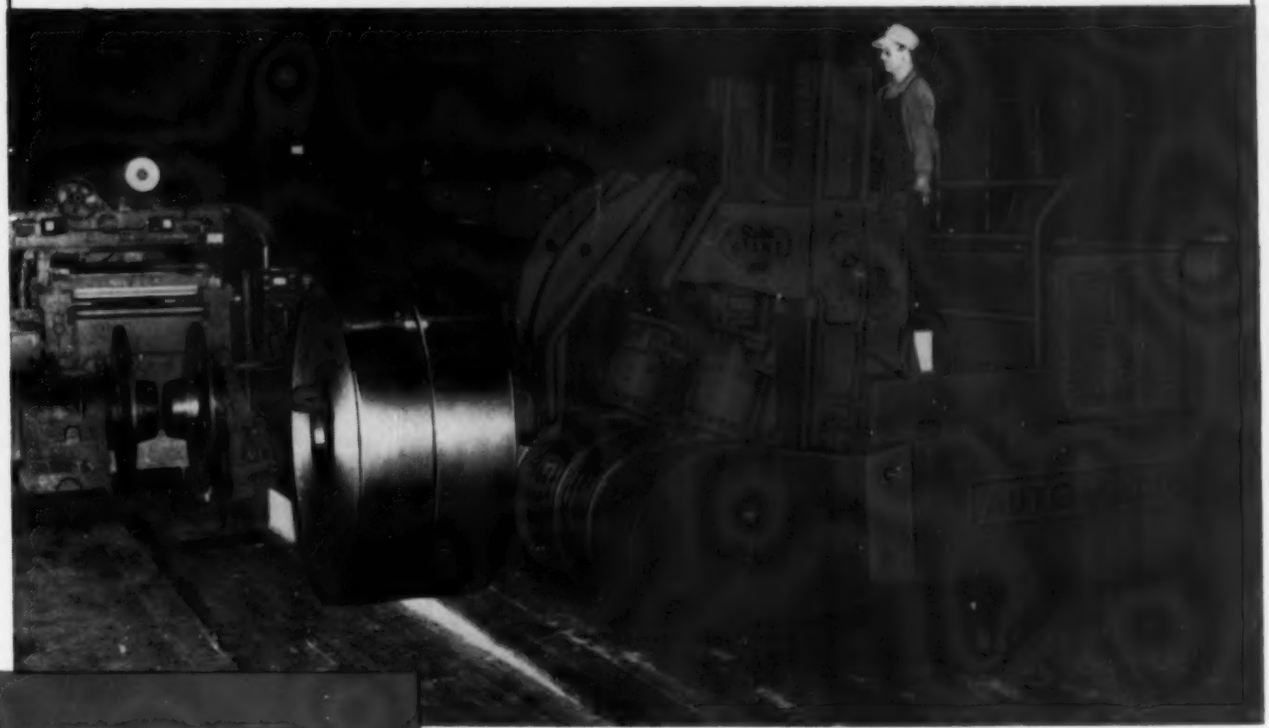
173 Mortimer St., Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd.,
Kitchener, Ont.
Branch Offices in all Principal Cities

Fans and Air Equipment by "Buffalo"

COMFORT - PRODUCT AND PROCESS CONTROL

ventilating	air tempering	forced draft
heating	air washing	induced draft
cooling	exhausting	pressure blowing

How Skylift GIANTS help produce more steel, faster!



ABILITY TO HANDLE 25,000 POUND STEEL COILS GIVES PRODUCTION TERRIFIC BOOST AT GRANITE CITY STEEL CO. NEW COLD STRIP MILL

In the effort to boost steel output, part of the solution has been found in the design of faster strip mills, capable of processing larger quantities of metal in a single operation and at increased speed. But, the new mills themselves added to the problem. How were they to be fed with the huge coils of steel they were capable of handling?

Granite City Steel Company, Granite City, Illinois, found the answer in the Skylift GIANT!

Operating at full speed, its new cold strip mill will produce enough steel in a 24-hour period to stretch from New York to St. Louis. Literally making this possible, are the Skylift GIANTS.

Huge coils weighing from 15 to 25,000 pounds are moved by Skylift GIANTS to the tandem cold strip mill where the hot rolled coil is reduced to cold strip. Again Skylift GIANTS move the coils to the electrolytic cleaner for removal of rolling oils.

And through every process until the tinplate is ready for shipment, Automatic's mighty giants of electric power handle coils large enough to meet every requirement of speed in delivering to and discharging coils from the mill. Result is 25% more coils processed at capacity operation.

Skylift GIANTS are specially engineered to handle all sizes, all weights of coils.

Four front drive wheels provide as much as 80 inches of rubber. Pivoted drive axles give constant 4-wheel traction regardless of floor conditions—controlled caster type trail axle, center-pivoted, compensate for uneven floor surfaces. Nearly 20% lighter in proportion to load capacity than other heavy-duty fork and ram tractors —Skylift GIANTS are the only heavy-duty trucks with HIGH PRESSURE HYDRAULIC LIFT that eliminate chains and sprockets.

Mail coupon for facts about how Skylift GIANTS offer *your business* amazing production and handling savings.

NATIONAL MATERIALS HANDLING EXPOSITION
PHILADELPHIA CONVENTION HALL

Skylift GIANT
A PRODUCT OF AUTOMATIC

AUTOMATIC TRANSPORTATION COMPANY
DIV. OF THE YALE & TOWNE MFG. CO.
47 W. 87th St. Dept. T-8, Chicago 20, Ill.

☐ Send details on Automatic's Skylift GIANTS Fork and Ram Trucks.

☐ Have an ATCO Specialist make a free survey of our material handling costs.

Company Name.....

.....

By.....

.....

Street Address.....

City.....

Zone.....*State*.....

Manufacturers of the Famous Transporters, Transtackers and Skylift Electric Trucks

DATE LINE DIARY...

September 1

▲ Voluntary Allocation programs, which have been set up, will take about 9 per cent of the steel shipment during the fourth quarter. Out of this allocation the armed forces will receive 102,500 tons monthly, Atomic Energy Commission 20,055 tons, warm air heating equipment 29,170 tons, prefabricated steel houses 59,000 tons, oil barges 20,000 tons, freight car program 248,250 tons, and tankers 40,380 tons.

▲ The cost of living adjustment incorporated in the General Motors contract should raise the average hourly wage rate starting today about 3 cents per hour.

September 2

▲ The Railroads in the east and south have asked the Interstate Commerce Commission for an increased rate of 20 cents per ton on coal, coke, and iron ore.

▲ In England, because of the increased cost of coal, price increases have been made on many steel products. Among these raises is 50 cents a ton on basic pig iron, $4.00 on billets, and $6.00 on wire.

September 7

▲ The operating rate of steel companies having 94 per cent of the steel capacity of the steel industry will be 94.5 per cent of capacity for the week beginning September 7, 1948, which is equivalent to 1,703,300 tons of steel compared to 1,716,000 tons one week ago.

▲ Price increases were announced today by Electro Metallurgical Sales Corporation on a number of products. Base price of 50 per cent ferrosilicon becomes 10.5 cents per pound on contained silicon. Ground 15 per cent ferrosilicon was raised $6.00 a gross ton. Standard ferromanganese is raised from $145.00 to $160.00 a gross ton and the cash discount is now eliminated. High-carbon ferrochrome alloy is increased 1.9 cents per pound of contained chromium. Price of vanadium and tungsten alloys remain unchanged.

September 8

▲ According to Business Week, cement mills cannot keep up with current demand and no relief is seen until cold weather slows building.

September 9

▲ The Tubing Division of Armco Steel Corporation voted yesterday to reject a proposal of the A. F. of L. to be their exclusive bargaining agent and by a vote of 59 to 3 indicated their preference for no union.

▲ Shipments of finished steel in the first seven months of 1948 were more than 1,300,000 tons higher than in the corresponding period of 1947. Shipments of cold rolled sheet set a monthly record in July of 583,417 tons.

September 10

▲ Mr. H. L. Erlicher, vice president in charge of purchasing and traffic, General Electric Company announced that the recent changeover from the basing point system of pricing steel together with increased freight costs, and steel price increases have added an estimated $8,000,000 to the General Electric Company's annual steel bill. The change in the method of pricing alone will cost the company more than a half-million dollars annually.

September 11

▲ Because of rail rate boosts and the change in the steel industry pricing system river traffic in 1948 will be approximately 30 per cent higher than in 1947 according to the Wall Street Journal. Freight traffic for the first eight months of the year, from which this estimate was made, has decreased about 3 per cent. The basic reason for this trend is that railroad freight rates have increased about 40 per cent and barge rate increases have only been about 20 per cent.

September 12

▲ Petroleum refineries in the United States, according to the Department of Commerce have a new record breaking operating capacity of 6,034,252 barrels of crude oil per day at the beginning of 1948, which is an increase of almost a half-million barrels daily compared with the previous year.

▲ The operating rate of steel companies having 94 per cent of the steel capacity of the industry will be 96.1 per cent of capacity for the week beginning September 13, 1948. This is equivalent to 1,732,200 tons of steel ingots and castings compared to 1,703,300 tons one week ago.

September 14

▲ In a release issued by the American Iron and Steel Institute, steel production for the first eight months of 1948 totaled 57,500,000 tons which is about 1,645,000 tons larger in the corresponding period of 1947. Electric furnace production for the first eight months of the year as well as the August production figure set a new all time record; 425,827 tons of electric furnace steel were produced in August and the eight months figure of electric furnace steel was 3,167,505 tons.

▲ Benjamin F. Fairless pointed out in an address last night that the recent Supreme Court ruling which resulted in the elimination of the multiple basing point of selling steel is a challenge to Pittsburgh's industrial well-being. The basic reason for this is that the Pittsburgh district produces more steel than is consumed in the area, and as distribution costs increase, it is more difficult to compete with mills who are more strategically located with respect to the marketing areas. The Pittsburgh industrial region must thus attract more steel fabricators to the area.

September 15

▲ According to Business Week, construction of new homes in 1948 will reach an all time peak. However, it is expected that this boom will soon slack off inasmuch as builders of new homes have just about caught up with the new families who are setting up housekeeping.

▲ Jones and Laughlin Steel Corporation has announced that they are planning to expand capacity in Pittsburgh. For this reason they have been acquiring land adjacent to their present plant. The expansion involves construction of new open hearths and also rebuilding of the present 20 ft diameter blast furnace, replacing it with one having a 24 ft hearth diameter.

▲ The American Iron and Steel Institute today said that the average hourly earnings of the wage earners in the steel industry reached a new peak in July of $1.645 per hour. Employment of 640,700 set a new post war record in July.

September 16

▲ In the Chicago area, United States Steel's plants are making strong efforts to maintain a full working force. The Gary Works of the Carnegie-Illinois Steel Corporation are building 500 new 6-room homes, and the South Chicago Works is sponsoring radio programs in order to recruit new workers.

▲ Republic Steel Corporation as a part of its modernization program is expected to electrify the bessemer plant at Youngstown. The steam boiler plant will then be eventually abandoned.

September 17

▲ The stainless steel market has finally caught up with production and an indication of this is that both the Carnegie-Illinois Steel Corporation and the Republic Steel Corporation have eliminated distribution on stainless to warehouses.

September 18

▲ A centralized buying agency is being set up to bring in German scrap by the National Scrap Dealers although the Justice Department must approve the proposal before it can take effect. The chief problem is to see that 440,000 tons of scrap from Germany earmarked for the United States are shipped.

September 19

▲ The outlook for power for the coming winter should be better than last winter. Although coal and fuel oil supplies are in fair supply, some shortages may occur in electric power and gas. Plant location will of course be an important factor. Many industries are working on a cooperative program which will reduce the peak load and are trying to spread requirements out of the peak periods.

September 20

▲ In a series of ads this week, the Wheland Company published copies of correspondence from the War Assets Administration on the Defense Plant Corporation furnace in Cleveland, Ohio. This is part of an attack by the company on the lease of the furnace to Henry J. Kaiser.

September 21

▲ The operating rate of steel companies having 94 per cent of the steel capacity of the industry will be 96.1 per cent of capacity for the week beginning September 20, 1948. This is equivalent to 1,732,200 tons of steel ingots and castings compared with the same amount one week ago.

September 22

▲ The Dupont Corporation announced that they are making titanium metal available at a nominal rate for organizations engaged in experimental or research work. Production is now under way from a pilot plant.

▲ Republic Steel Corporation estimates that they are losing up to 15,000 tons of steel a month because of labor shortages.

September 23

▲ Andrew H. Phelps, vice president in charge of purchasing, Westinghouse Electric Corporation stated that the August steel production of almost 7,500,000 tons or an annual rate of about 90,000,000 tons a year was still insufficient to handle the programs which they are now contemplating. He thus joins the group of government economists and union leaders who are advocating additional steel capacity.

▲ The first of a series of regional technical meetings was held in Pittsburgh today by the American Iron and Steel Institute. The meeting was attended by some 450 delegates.

▲ The Inland Steel Company will appeal the decision handed down by the United States Circuit Court of Appeals which upheld the validity of the NLRB order requiring the company to bargain with the United Steelworkers of America over provisions of the company's voluntary retirement plan.

▲ SKF Industries, Inc. have announced that they will increase prices on October 1 on most of their products. These increases will average less than 10 per cent.

September 24

▲ The American Military Government announced that the iron and steel industry in Western Germany set a new production record in August with 510,000 metric tons of ingots. Pig iron production was 433,500 metric tons, and finished steel products was 344,500 metric tons.

▲ Building and construction activity east of the Rockies in August has increased about 4 per cent over August 1947 with a figure of $854,091,000. However, there is a normal decline which amounts to 7 per cent compared with the previous month of July.

▲ A large group of the corn products industry warned the Federal Trade Commission yesterday that the requirements of uniform net pricing promotes monopoly. This is in protest to the f.o.b. mill pricing sought by the commission.

September 26

▲ Imports of pig iron into the United States for the first six months of 1948 averaged over 8,000 tons per month and in July and August they averaged about 15,000 tons. One of the new sources of pig iron is Germany. The largest shipper is Holland. Other countries shipping include Belgium, France, Norway, Sweden and Australia.

September 27

▲ J. P. Parry, vice president of Turner Construction Company, in an address stated that in their judgment building costs are not likely to come down in the immediate future, nor are they likely to come down more than 10 per cent in the next five years unless there should be a war or a great depression. Consequently they are advising their clientele not to postpone construction.

▲ The operating rate of steel companies having 94 per cent of the steel capacity of the industry will be 96.4 per cent of capacity for the week beginning September 27, 1948. This is equivalent to 1,737,600 tons compared to 1,732,200 tons one week ago.

September 28

▲ Production of pig iron in August set a post-war monthly record of 5,204,204 net tons.

▲ Estimated total bookings of fabricated structural steel for August were 163,963 tons down slightly from July, but was 12 per cent greater than the previous year.

September 29

▲ The American Iron and Steel Institute announced today that steel mill customers were getting 61 per cent as much metal for their dollar as in 1939, although buyers of corn, pork, beef, butter obtained only 20 to 30 per cent of the quantity their dollar brought before the war.

September 30

▲ The American Iron and Steel Institute announced record shipments of steel have enabled manufacturers to make gains in their order backlogs. Made since the war are approximately 11,000,000 autos and trucks; 7,500,000 electric refrigerators; 8,000,000 washing machines; 166,000 domestic freight cars; more than 10,000,000 stoves and ranges; 22,000,000 electric irons; 2,000,000 non-farm dwelling units; 217,000,000 steel barrels, drums and pails; about 4,700 miles of gas pipe lines; about 7,500 miles of oil pipelines; and several million units of various types of new farm machinery.

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Pages 17 and 18

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BOOK REVIEWS

A reference book to help electrical engineers understand and apply new electronic equipment in industry has just been published by John Wiley and Sons, New York City.

Prepared by electronics and research engineers of the Westinghouse Electric Corporation, the 680-page Industrial Electronics Reference Book contains 36 chapters on the basic theory of electrons and the design, application and maintenance of electronic equipment in industry This handbook includes within one cover all the technical data needed to understand the scope and limitations of electronic equipment as used in industry. It will be useful to engineers faced with the problems of approving or rejecting industrial electronic equipment.

The chapters, all well illustrated, were written by engineers and research scientists who have made many contributions to the rapid development of the field of electronics. They include Dr. W. E. Shoupp, manager of electronics research for Westinghouse, a co-discoverer of photo-fission of uranium atoms by gamma rays, and Dr. Harvey C. Rentschler, retired director of Westinghouse lamp and electronic tube research—the man who developed the Sterilamp which kills air-borne bacteria by ultra-violet radiation.

Besides presenting underlying theories and design factors, the book brings the electrical engineer up to date on developments in electronic instruments, motor control, dielectric heating of woods and plastics, resistance welding, X-ray and photo-electric devices and many other fields of electronics.

Chapters 1 through 3 cover the basic laws governing the production and control of electrons, the kinetic theory of gases, atomic structure and the electrons theory of solids.

Chapters 4 through 10 embrace the design, operation and construction features of different types of electronic tubes — vacuum tubes, gas tubes, X-ray tubes, cathode-ray tubes, photo-electric devices and ultra-violet radiators.

Electronic circuit components including resistance forms, capacitance, oscillators and control circuits are presented in Chapters 11 through 18, while the design and application factors relating to transmission lines and antennas are covered in Chapters 19 and 20.

The many different types of industrial equipment — including power-line carrier equipment, power rectifiers and inverters, radio frequency heating and electronic instruments—are presented with their advantages and limitations for industrial use in Chapters 21 through 34.

The two final chapters outline the factors involved in the care and maintenance of electronic tubes and apparatus.

The Industrial Electronics Reference Book, measuring 9 x 11 in., can be obtained from John Wiley and Sons, 440 Fourth Avenue, New York 16, New York. Its price is $7.50.

▲ The new addition of the American Standards for Transformers, Regulators, and Reactors, just released by the American Standards Association, Incorporated, is expected to have special significance because of the greatly increased demand for electrical equipment in the post war construction program. The 1948 production of power and distribution transformers alone has been estimated to run as high as $200,000,000.

The 1948 edition is the result of long cooperation between manufacturer and user groups who have been working together for many years to bring about an effective codification of transformer practice in a document so clear and comprehensive that no one can fail to understand it. Standard practices originally presented in publications of the American Institute of Electrical Engineers, the National Electrical Manufacturers Association, and the Edison Electric Institute, form the basis for the document.

The standards provide a common yardstick by which users may evaluate bids for new equipment, thus offering a fair basis for competition among all producers of transformers.

Copies of the 1948 edition of the American Standards for Transformers, Regulators, and Reactors, C57, can be obtained from the American Standards Association at $4.00 each.

▲ PB-345 (*Steelmaking in Belgium and Luxemburg during the German occupation*; mimeographed, 25 cents; 20 pages) summarizes steel production in the two countries and describes in detail the manufacture of H. P. N. (Hamborn, low P, low N) steel made in basic Bessemer converter. The report gives test procedures and results of tests of this steel. Recovery of vanadium from pig iron is extensively discussed.

PB-346 (*Burbach Eisenhutte, Saarbruken—Metallurgy*; mimeographed, 10 cents; 18 pages) describes the integrated operations of this alloy steel firm. Included in the report is information on desulphurization of liquid pig iron by the use of liquid soda ash, recovery of vanadium from pig iron, and improvement of coke oven gas by the still process. Production figures for 1936-1944 are given.

PB-349 (*Friedrich-Alfred-Hutte at Rheinhausen*; mimeographed, 25 cents; 22 pages) describes production at one of the steel works of the Krupp firm. It includes information on personnel, extent of plant, raw materials, coke ovens, sintering machines and screening plant, blast furnaces, basic bessemer converters, open hearth and electric furnaces, surface conditioning, rolling mills, statistics on production and inventory.

PB-351 (*Gebruder Bohler A. G. Buderich — Metallurgy*; mimeographed, 25 cents; 28 pages) describes metallurgical processes employed by this Austrian firm at Buderich, Germany. The firm made high quality steels, steel tools and forgings. The company's production of hard cemented carbides, believed by the investigator to be typical of German war production of standard hard metal products, is described in particular detail. The company is reported to have used electric furnaces exclusively for steel production. The two-slag basic practice was employed in most instances. The one-slag basic practice was employed for high-speed steels and chromium-containing steels using carefully selected scrap. The report contains analyses and monthly tonnage figures of products under normal operations.

PB-352 (*Deutsche Edelstahlwerke-Krefeld, Germany*; mimeographed, 25 cents; 20 pages) describes operation at this plant and gives complete layout of steel mill, and discusses in detail organization and parts of the plant. High alloy steels were made at this plant. Chemical specifications for steels produced are given.

PB-27007 (*Report on investigation of raw materials used in German iron and steel industry*; mimeographed, $3.25; 123 pages) is a survey of 8 German iron and steel works. According to the report, officials of the Krupp firm believed that 25 per cent oxygen content in the blow would increase steel production and reduce coke consumption in the blast furnaces. Similar installations, to bring the oxygen content of the blast up to 30 per cent, were planned by Krupp for the basic bessemer converters. The report contains information on German methods for reducing the nitrogen content of basic bessemer steel. According to metallurgists at the August Thyssen Hutte in Hamborn, nitrogen content can be reduced by maintaining low temperatures in the converter and by reducing the duration of the blow. In addition to iron and steel production methods, the report describes processes used for making ring springs, gun tubes, and other finished steel products and discusses the German steel industry's raw material supply.

PB-81385 (*Utilization of oxygen in the German iron and steel industry*; mimeographed, 75 cents, 26 pages) describes the use of oxygen-enrichment in blast furnaces and data on experiments conducted at the Gute Hoffnungs Huette at Oberhausen since 1933. The report also contains data on the use of oxygen in basic converters at another steel works, and details on low shaft blast furnaces at two other plants.

Orders for the reports should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C., and should be accompanied by check or money order payable to the Treasurer of the United States.

▲ "Hot-Dip Galvanizing Practice," by William H. Spowers, Jr., second edition, is written in non-technical language and discusses the latest, most improved and efficient galvanizing methods. It contains 23 chapters describing in detail various steps involved in galvanizing straight and tight-coat wire, poultry netting, hardware cloth, pipe fittings, sheets, stamped metalware, and range boilers. The procedure to be followed in building a typical modern galvanizing plant is presented in detail. Such phases as electrically-heated kettle settings, pyrometry, how to reduce dross losses, types and chemical reaction of fluxes and other subjects will be valued by manufacturing galvanizers and their metallurgists, chemists and shop personnel.

▲ "Modern Metallurgy of Alloys" by R. H. Harrington, Research Metallurgist for the General Electric Company, is of interest to all industrial research and works laboratories, and to metallurgists generally, for the emphasis is on the often-neglected "whys" of alloying, as well as on procedure and method. The author clarifies the confusing terminology which heretofore has needed a modernized, definitive system, and he correlates as well, modern theory with practical data, including the fundamentals of a new field of alloy treatments.

Subjects covered include fundamental factors for alloying; positive alpha boundary; peritectoid reactions; double aging with intermediate plastic strain; beta tungsten structure; physics of metals; and lattice vacancies. A metallurgist's periodic table compiles the most accurate data available on the atomic properties that are important to the fundamental alloying principles. The 49 figures and 30 tables illustrate the subjects discussed and tabulate helpful information. This book is published by John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, New York cloth bound, 209 pp, price $3.50.

▲ The following two new standards have been published and copies are available for distribution: "NEMA Definitions for Marine-propulsion Steam Turbines and Gears, Publication No. 48-133."

The publication contains general definitions for marine-propulsion steam turbines and gears and definitions of the types of turbine, turbine arrangements, and various gear arrangements. 24 pp, $2.00.

"EEI-NEMA Recommended Standards for Distribution Transformers, NEMA Publication No. 114." This fourth report of the joint committee of EEI and NEMA on standards for distribution transformers contains design standards for certain mechanical and electrical features of overhead-type single- and three-phase distribution transformers. 16 pp, $0.80. Both publications may be obtained by writing NEMA, 155 East 44th Street, New York 17, New York.

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